Architect's Stainless Steel Library

DESIGN MANUAL

SECOND EDITION

INTERNATIONAL NICKEL

PREPARED IN COOPERATION WITH COMMITTEE OF STAINLESS STEEL PRODUCERS, AMERICAN IRON AND STEEL INSTITUTE

JEFFERSON WESTWARD EXPANSION MEMORIAL, ST. LOUIS, MISSOURI
Architects: Eero Saarinen and Associates

Foreword

This Design Manual presents, in a concise, easily referable format under a single cover, a wide range of basic information about the uses of stainless steel in architecture. While the manual is primarily directed to the practicing architect, it should also serve as an excellent introductory text for the architectural student.

The manual contains information on the characteristics and basic properties of the various stainless steel types, a composite listing of the dimensional and finish availability of various standard mill products, and descriptions of the principal methods used in fabricating and joining architectural components and assemblies. In addition, a variety of stainless steel installations and products are discussed with examples presented in sufficient detail to illustrate the principles.

Since the choice of subject matter presented has, in many instances, been arbitrary and space limitations preclude exhaustive treatment of the material, architects are encouraged to seek additional information and assistance from experienced stainless steel fabricators and product manufacturers. Additional information may also be obtained from The International Nickel Company district offices listed in the back of this manual.

THE INTERNATIONAL NICKEL COMPANY, INC.

Contents

Properties

This section is an introduction to the family of chromium-steel alloys known as stainless steel. In addition to a discussion of the A.I.S.I. system of classification and the uses of the various alloys, the chemical composition and mechanical and physical properties of the principal alloys used in architectural applications are summarized in tabular form.

CLASSIFICATION & TYPE

Stainless steels make up a family of corrosion and heat resistant iron-base alloys containing a minimum of about 12% chromium. The corrosion resistance is improved by increasing the chromium content. Both corrosion resistance and fabricating characteristics are further improved through modification with nickel and other elements.

CLASSIFICATION: Stainless steels may be broadly divided into three groups according to composition and metallurgical characteristics: *austenitic*, *ferritic* and *martensitic*. They are further standardized and classified according to a numbering system established by the American Iron and Steel Institute. In the AISI system the austenitic stainless steels are assigned numbers in the 300's and 200's and the ferritic and martensitic steels, numbers in the 400's.

Austenitic Stainless Steels—(AISI 300 and 200 series)—contain chromium and nickel, or chromium, nickel and manganese, with or without moderate additions of other elements. These steels are normally non-magnetic. They cannot be hardened by heat treatment, but they may be hardened materially by cold working. The austenitic stainless steels are characterized by a combination of properties that are especially suitable for architectural metal applications. These include excellent corrosion resistance, high strength and ease of fabrication. They account for about two-thirds of stainless steels produced and comprise a much greater percentage of those used in building construction.

Ferritic Stainless Steels—(AISI 400)—contain chromium as the primary alloying element and are magnetic. They are hardened only slightly by heat treatment and can be hardened moderately by cold working. They are readily fabricated but do not retain as much ductility as the austenitic grades after cold working.

Martensitic Stainless Steels—(AISI 400 series)—are iron-chromium alloys with or without small additions of alloying elements. Steels in this group are magnetic. They may be hardened by heat treatment as ordinary carbon steel.

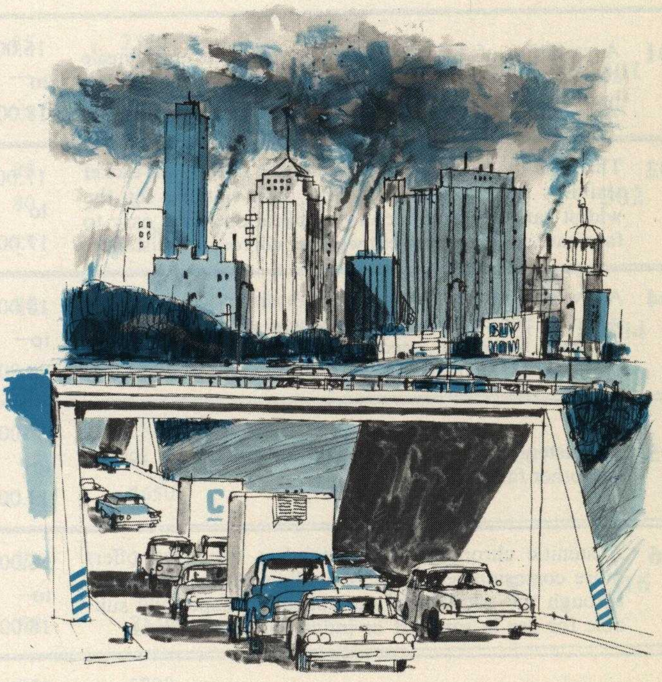
The stainless steels most commonly used in architectural applications are AISI Types 201, 202, 301, 302, 304, 305, 316 and 430 with Types 302 and 304 comprising the largest usage. Representative physical and mechanical properties of these steels are summarized in Table 1.

ATMOSPHERIC CORROSION RESISTANCE

In selecting architectural metals, a number of performance characteristics should be considered. These include:

1. Ability to retain appearance
2. Compatibility with other materials
3. Ability to retain structural strength
4. Low maintenance cost

Stainless steels meet the test of these considerations. Their corrosion resistance provides architectural products which last the life of any building, require minimum maintenance and protect associated building components from staining by corrosion products. They have an excellent ability to retain their characteristic metallic luster, even under years of accumulated industrial soot and grime. Furthermore, when cleaned, the original appearance of the metal is restored.



PROTECTIVE MECHANISM: Stainless steels resist corrosion because of their ability to take advantage of the oxygen in the atmosphere to form an invisible oxide film which prevents further attack. Maximum benefits from the effects of atmospheric oxygen may be obtained by minimizing opportunities for accumulation of dirt and polluted liquids in crevices and pockets. See design details of examples in the Applications and Architectural Products Section.

REPRESENTATIVE PROPERTIES

ALLOYS COMMONLY USED FOR ARCHITECTURAL APPLICATIONS

TYPE	DESCRIPTION	CHEMICAL COMPOSITION: CHROMIUM	NICKEL	CARBON	MANGANESE	SILICON	OTHER ELEMENTS
201	An austenitic chromium-nickel-manganese stainless steel with many of the same properties as Type 301, but having higher yield and tensile strengths.	16.00 to 18.00	3.50 to 5.50	0.15 Max.	5.5 to 7.5	1.00 Max.	N 0.25 Max.
202	An austenitic chromium-nickel-manganese steel with much the same properties as 302, but having higher yield and tensile strengths.	17.00 to 19.00	4.00 to 6.00	0.15 Max.	7.5 to 10.0	1.00 Max.	N 0.25 Max.
301	A variation of 302 which can be rolled to high tensile strengths for special applications. It is used when higher strengths are required.	16.00 to 18.00	6.00 to 8.00	0.15 Max.	2.00 Max.	1.00 Max.	
302	This was the original basic austenitic chromium-nickel stainless steel. Along with 304, it is suitable for the widest range of architectural applications. It is easy to fabricate and has excellent weather corrosion resistance.	17.00 to 19.00	8.00 to 10.00	0.15 Max.	2.00 Max.	1.00 Max.	
304	A low-carbon variation of 302 with similar corrosion resistance. Sometimes specified where extensive welding of heavy sections is needed. It is the type most readily available in many forms; is interchangeable with 302.	18.00 to 20.00	8.00 to 12.00	0.08 Max.	2.00 Max.	1.00 Max.	
305	An austenitic stainless steel used for bolts, nuts, screws and other fasteners.	17.00 to 19.00	10.00 to 13.00	0.12 Max.	2.00 Max.	1.00 Max.	—
316	Austenitic chromium-nickel stainless steel that offers more corrosion resistance, including pitting resistance, through the addition of molybdenum. Especially suitable for use in seacoast or industrial atmospheres.	16.00 to 18.00	10.00 to 14.00	0.08 Max.	2.00 Max.	1.00 Max.	Mo 2.00 to 3.00
410	A chromium stainless steel used for mechanical fasteners.	11.50 to 13.50	0.50 Max.	0.15 Max.	1.00 Max.	1.00 Max.	—
430	A ferritic chromium stainless steel with lower corrosion resistance than the 200 and 300 series; used mainly for interior applications. It can be modified for improved weldability, corrosion resistance, and heat resistance.	14.00 to 18.00	0.05 Max.	0.12 Max.	1.00 Max.	1.00 Max.	

TABLE 1

MECHANICAL PROPERTIES (annealed) **PHYSICAL PROPERTIES** **TYPE**

PRODUCT FORM	YIELD STRENGTH .2% OFFSET LB./IN.^{2} (1,000 psi)	TENSILE STRENGTH LB./IN.^{2} (1,000 psi)	MODULUS OF ELASTICITY LB./IN.^{2} x 10^6	ELONGATION % IN 2 IN.	HARDNESS ROCKWELL B	MELTING RANGE °F	WEIGHT LB./IN.^{3}	THERMAL CONDUCTIVITY BTU/FT^2/HR/°F/FT (212°F)	COEFFICIENT OF THERMAL EXPANSION IN./IN./°Fx10^{-6} (32° TO 212°F)	TYPE
SHEET	55	115		55	90					
PLATE	—	—	28.6	—	—		0.28	9.4	8.7	**201**
BAR	—	—		—	—					
SHEET	55	105		55	90					
PLATE	—	—	28.6	—	—		0.28	9.4	10.2	**202**
BAR	—	—								
SHEET	40	110		60	85	2550				
PLATE	40	105	28.0	55	—	to	0.29	9.4	9.4	**301**
BAR	—	—		—		2590				
SHEET	40	90		50	85	2550				
PLATE	35	90	28.0	60	80	to	0.29	9.4	9.6	**302**
BAR	35	85		60		2590				
SHEET	42	84		55	80	2550				
PLATE	35	82	28.0	60	—	to	0.29	9.4	9.6	**304**
BAR	35	85		60		2650				
SHEET	38	85		50	80	2550				
PLATE	35	85	28.0	55	—	to	0.29	9.4	9.6	**305**
BAR	—	—		—		2650				
SHEET	42	84		50	79	2500				
PLATE	36	82	28.0	55	—	to	0.29	9.4	8.9	**316**
BAR	30	80		60	78	2550				
SHEET	45	70		25	80	2700				
PLATE	35	70	29.0	30	—	to	0.28	14.4	5.5	**410**
BAR	40	75		35	82	2790				
SHEET	50	75		25	85	2600				
PLATE	40	75	29.0	30	—	to	0.28	15.1	5.8	**430**
BAR	45	75		30		2750				

USE OF TYPE 302 AND TYPE 304: Types 302 and 304 stainless steels have a record of highly satisfactory performance in industrialized cities. The corrosion resistance of these basic types of nickel stainless steel is well demonstrated by the Chrysler Building in New York City where Type 302 stainless steel sheathing has withstood the effects of weather for a period of more than forty years.

USE OF TYPE 316: Resistance to severe exposure conditions can be increased by the addition of special alloying elements. For example, molybdenum, when added to the base 18% chromium-12% nickel composition of Type 316 stainless steel, effectively increases its corrosion resistance to atmospheric chlorides. For this reason Type 316 is preferred for use in coastal environments especially where there are frequent fogs and heavy dews and extended periods between rains. It is also suitable for installation near chemical plants which process halogen compounds.

The addition of molybdenum also improves the resistance of nickel stainless steel to damp sulfurous atmospheres that result from the burning of high sulfur fuels in localities where the relative humidity is high.

COMPATIBILITY WITH OTHER MATERIALS: Stainless steels perform well with other building materials. In addition to having excellent corrosion resistance themselves, stainless steels are the least active metals in accelerating galvanically the corrosion of other architectural metals such as aluminum and steel. That is why nickel stainless steel fasteners are preferred for joining aluminum.

Stainless steels have the advantage over copper and high copper-content alloys of not releasing corrosion products that cause accelerated attack on aluminum or zinc surfaces with which they come into contact by drainage. This feature is also important in avoiding unsightly staining of marble or other masonry located below or adjacent to the metal in a structure. Because stainless steels are also resistant to masonry alkalinity, they are especially suitable for stone anchors and other masonry accessories.

CORROSION DATA: The phenomenon of corrosion of metals has been the subject of considerable investigation, and a further discussion of it here is considered inappropriate. Interested readers are referred to INCO's publication, "Corrosion in Action," to aid in understanding the electrochemical processes that produce corrosion. This publication and other reference material on corrosion are available upon request.

HARDNESS & STRENGTH

The tensile strength of annealed chromium nickel stainless steels generally ranges between 80,000 and 110,000 p.s.i. and is accompanied by high ductility. Hardness is related to tensile strength and is generally between 80 and 85 Rockwell B.

Most stainless steels used in architecture are annealed. Following annealing a light cold rolling operation imparts the final mill finish and improves flatness. This final milling operation work hardens the stainless slightly, particularly the skin or surface, and accounts for some of the stiffness and springback associated with stainless.

For roofing and flashing applications springback is undesirable, so a dead soft, fully annealed product is also produced by many mills. This product has lower tensile strength (about 80,000 p.s.i.), hardness (about 75 Rockwell B) and minimum springback.

Where higher strengths and hardness levels are required for particular applications, Type 301 is usually selected as it work hardens more rapidly than other types. When cold rolled to ¼-hard, ½-hard, ¾-hard and full hard tempers, the effect on tensile strength and yield strength is as follows:

MINIMUM TENSILE PROPERTIES OF COLD ROLLED SHEET AND STRIP—TYPE 301

Temper	Tensile Strength, psi	Yield Strength (0.2% offset), psi	Elongation (in 2 inches), %	Rockwell C Hardness
Annealed	85,000	30,000	60	—
¼-Hard	125,000	75,000	25	25
½-Hard	150,000	110,000	15 or 18	32
¾-Hard	175,000	135,000	10 or 12	37
Full Hard	185,000	140,000	8 or 9	41

The forming characteristics of stainless in these tempers are much different than for annealed stainless, and the architect should not specify them without consulting a stainless producer or a qualified fabricator. Without a specification of temper or hardness, annealed stainless will be supplied and is recommended for most architectural applications.

Mill Products

This section describes the various products of the stainless steel producers' mills that are generally used in architecture. The products of many producers are organized according to product designation to provide a single reference for mill product availability.

INTRODUCTION

Familiarity with mill product availability can often help the architect achieve simple and economical solutions to design problems. For example, rectangular tubing or structural shapes modified by simple cuts can sometimes be used in lieu of more expensive custom formed shapes.

This section describes the various products of the stainless steel producers' mills that are generally used in architecture. The products of many producers are organized according to product designation to provide a single reference for mill product availability.

Product designations are defined, and information on finish availability is provided. Dimensional availability is presented in tabular form. The products described are limited to those generally available from producers and steel service centers. Tables show availability in Types 302 and 304, the primary alloys used in architecture.

Mill products in other sizes, finishes and alloys, which may also be of interest to the architect, are referenced in the text. The many products of fabricating specialists, such as roll formers, are not included in this section.

Since producer capabilities and service center inventories of mill products in stock are subject to change, it is suggested that designers check with producers and service centers prior to specifying mill products to verify availability.

PLATE

AVAILABILITY: Stainless steels are regularly produced in a wide range of plate sizes. The table below does not list thicknesses greater than ½″ only because heavier plate is seldom specified for architectural use. Information on the availability of heavier plate can be obtained from producers and suppliers.

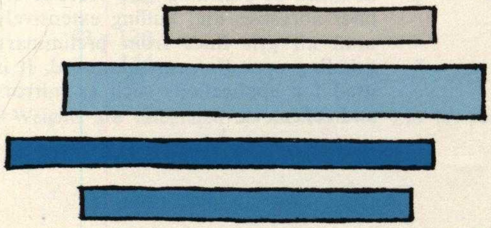


Plate Thicknesses — Plate is readily available in thicknesses from $^3/_{16}$″ to 3″ and over. Products $^3/_{16}$″ to ½″ thick are generally stocked in increments of $^1/_{16}$″.

Plate Width and Length—Standard stainless steel plate widths range from 36″ to 96″ in 12″ increments. Standard lengths are 120″, 240″ and 360″.

Cutting—Straight shearing cuts are made in plate up to ½″ in thickness. Plate is also available cut to any desired shape by burning.

TYPES: The plate availability listed is for Types 302 and 304. Type 316, with higher corrosion resistant properties, is also widely available in plate form.

FINISHES: Plate may be specified in the standard hot rolled, annealed and pickled condition.

Plates are also available from stock with improved surfaces. In this case, the annealed and pickled plate has been given a final cold roll or skin pass.

Producers and fabricators also grind and polish the surface of plate for results similar to stainless steel sheet finishes.

PLATE AVAILABILITY

Size		Thickness $^3/_{16}$″	¼″	$^5/_{16}$″	⅜″	$^7/_{16}$″	½″
Lbs. per Sq. Ft.*	300 series	7.83	10.44	13.05	15.66	18.27	20.88
	400 series	7.56	10.08	12.60	15.12	17.64	20.16
36 x 96		x	x	x	x		x
120		x	x	x	x		x
240		x	x	x	x		x
48 x 120		x	x	x	x	x	x
240		x	x	x	x	x	x
360		x	x	x			
60 x 120		x	x	x	x	x	x
240		x	x	x	x	x	x
360		x					
72 x 120		x	x	x	x	x	
240		x	x	x	x	x	x
360		x			x		x
84 x 120		x	x	x	x	x	x
240		x	x	x	x	x	x
360		x	x	x	x		x
96 x 120		x	x	x	x	x	x
240		x	x	x	x	x	x
360		x	x		x		x

*Weights are calculated on the basis of 0.29 lb. per cu. in. of chromium-nickel steel or 0.28 lb. per cu. in. of high chromium steel.

SHEET & STRIP

PRODUCT DESIGNATION: Flat rolled products under 3/16″ thick are designated as sheet or strip. Products 24″ and over in width are referred to as sheet and most products under 24″ as strip. However, stock under 3/16″ thick in the standard polished finishes is designated as sheet, regardless of width.

AVAILABILITY: Sheet sizes available from producing mills and steel service centers are listed in the accompanying table.

Sheet Widths—In most 18-gauge and heavier sheet, the stock widths range from 24″ through 60″ or 72″. In most 20-gauge and lighter sheet, the maximum stock widths are 36″ or 48″. Standard sheet widths increase in increments of 6″.

Sheet Lengths—Sheets 24″ and 30″ wide are offered in lengths of 96″ and 120″. Most wider sheets are available in lengths of 120″ and 144″. Many high-demand sheets are commonly offered in all three lengths: 96″, 120″, and 144″.

Coils—Sheet and strip are widely available in economical coil form for use with production equipment or for applications requiring material in the popular 16- to 26-gauge range in widths of 36″ and 48″. Some strip products (widths under 24″) are also stocked, and sheet or strip coils can be slit at the mill or steel service center to obtain narrow widths when required.

TYPES: Types 302 and 304 are the preferred alloys for nearly all exterior stainless steel applications in architecture. Type 304 is the most widely available. Type 316 chromium-nickel-molybdenum stainless steel and the straight chromium Type 430 are also widely stocked in many sizes. Many producers and steel service centers also carry a good selection of sheet in Type 301. The 200 Series nickel-manganese-chromium grades are more limited in availability.

FINISH DESIGNATIONS: The following numbered descriptive system of standard mill finishes, established by the American Iron and Steel Institute, is generally recognized and used:

STANDARD MECHANICAL FINISHES

Unpolished Finishes:

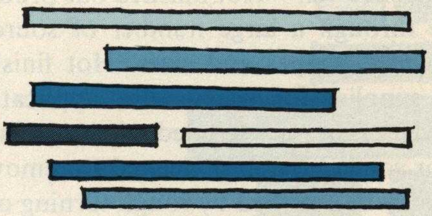
No. 1	A rough, dull surface produced by hot rolling to the specified thickness, followed by annealing and descaling.
No. 2D (for widths under 24″, referred to as "No. 1 Strip Finish")	A dull finish produced by cold rolling followed by annealing and descaling and sometimes by a final light roll pass on dull rolls.
No. 2B (for widths under 24″, referred to as "No. 2 Strip Finish")	A bright, cold rolled finish commonly produced in the same way as No. 2D finish, except that the annealed and descaled sheet receives a final light cold roll pass on polished rolls. This is the general purpose cold rolled finish.
No. 2B Bright Annealed	A bright, cold rolled, highly reflective finish is retained in final annealing by a controlled atmospheric furnace.

Polished Finishes:

No. 3	An intermediate polished surface obtained by finishing with a 100-grit abrasive. Generally used where a semi-finished polished surface is required. It may or may not be additionally polished during fabrication.
No. 4	A polished surface obtained by finishing with approximately a 150-mesh abrasive or finer, following initial grinding with coarser abrasives.
No. 6	A dull satin finish having lower reflectivity than No. 4 finish. It is produced by Tampico brushing the No. 4 finish in a medium of abrasive and oil.
No. 7	A high degree of reflectivity, which is obtained by buffing finely ground surfaces but not to the extent of completely removing the "grit" lines. It is used chiefly for architectural and ornamental purposes.
No. 8	The most reflective surface, which is obtained by polishing with successively finer abrasives and buffing extensively until all grit lines from preliminary grinding operations are removed. It is used for applications such as mirrors and reflectors.

Samples—Since standard finishes may vary slightly on different products and because many nonstandard finishes are available, the architect may wish to consult producers or fabricators and examine samples before making important finish specifications.

Finish availability—Sheet products are available in all of the AISI standard mechanical finishes. However, No. 2B cold rolled finish, usually subsequently refinished by the fabricator, and No. 4 polished finish are the most commonly used in architecture and are generally available in stocked sheet. Sheets in some non-standard proprietary finishes are stocked by steel service centers, and others are available from mills only. See page 22 in the Fabrication section for a general discussion of these.



SHEET AVAILABILITY

		Thickness													
Gauge		8	9	10	11	12	14	16	18	20	22	24	26	28	30
Decimal Equivalent (Inches)		.172	.1562	.1406	.125	.1093	.0781	.0625	.050	.0375	.0312	.025	.0187	.0156	.013
Wt. per Sq. Ft.* (Lbs.)	300 series	7.219	6.563	5.906	5.250	4.594	3.281	2.625	2.100	1.575	1.313	1.050	0.788	0.656	0.525
	400 series	7.081	6.438	5.793	5.150	4.506	3.219	2.575	2.06	1.545	1.288	1.030	0.773	0.644	0.515
Size															
24 x	96			x		x	x	x	x	x	x	x	x		
	120			x	x	x	x	x	x	x	x	x	x		
30 x	96					x	x	x	x	x	x	x	x	x	
	120					x	x	x	x	x	x	x	x	x	
36 x	96			x	x	x	x	x	x	x	x	x	x	x	
	120	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	144					x	x	x	x						x
42 x	96				x	x	x	x	x	x	x	x	x		x
	120				x	x	x	x	x	x	x	x	x		
48 x	96			x	x	x	x	x	x	x	x	x			
	120			x	x	x	x	x	x	x	x	x		x	
	144	x		x	x	x	x	x	x	x	x	x			
54 x	120				x	x	x	x	x						
56 x	96							x	x						
	120							x	x						
60 x	96					x	x	x							
	120			x	x	x	x	x	x						
	144	x		x	x	x	x	x	x						
72 x	120			x		x		x							
	144			x	x	x	x	x							

*Weights are calculated on the basis of 0.29 lb. per cu. inch of chromium-nickel steel or 0.28 lb. per cu. inch of high chromium steel.

BAR

PRODUCT DESIGNATION: Stainless steel bar products are designated by finishing method as indicated below:

Hot Finished Bar—Hot finished bar products are available through a large number of sources in a wide range of shapes and sizes. Hot finished bar products supplied for architectural applications are hot rolled, forged or extruded, then annealed and pickled or sometimes blast cleaned to remove scale. Rounds may be descaled by rough turning or grinding.

Cold Finished Rounds—Cold finished bar products are generally available from fewer sources and in a less extensive range of sizes than hot finished products. Cold finished bar is produced by the same methods as hot finished products and is annealed but is subsequently finished by one of several methods to provide closer dimensional tolerances and a smoother surface than hot finished products. Rounds are cold drawn or centerless ground. Other shapes are cold drawn or cold rolled. Cold finished rounds, squares and hexagons ½″ and under and cold finished flats 3/16″ x ⅜″ and under, though technically wire products, are commonly listed with bar stock by producers and steel service centers.

AVAILABILITY: Bar products are widely listed in all the standard shapes and finishes. Cold Finished Flats—Annealed and cold drawn flat bars are available from a number of producers and steel service centers. Thicknesses of 3/16″, ¼″, ½″ and ¾″ are carried. A selection of widths from ¾″ through 3″ is available in most of these thicknesses. Exceptions: 3/16″ stock starts at ½″ width; ¾″ stock is offered in 1″, 1½″ and 2″ widths.

Hot Finished Flats—A full selection of hot finished flat bar is available throughout the country. It is normally offered in the annealed and pickled condition.

Thickness—Available thicknesses range from ⅛″ through 2″. Thicknesses increase in increments of ⅛″ up to about ¾″ and in increments of ¼″ for flats thicker than ¾″.

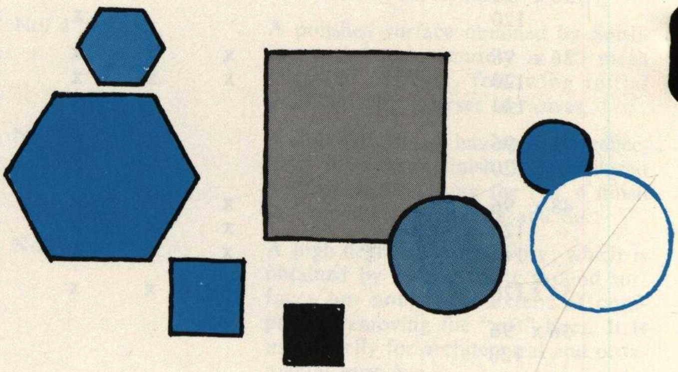
Widths—A full range of widths from ½″ to 6″ is generally stocked in thicknesses of ¼″ and ⅜″. Flats thinner than this generally run from ½″ to 3½″ in width. Heavier bars range from nearly or actually square in each thickness up to 6″ wide. Widths increase by increments ranging from ⅛'s to ¼'s to ½'s to full inches, with the size of increments increasing with width.

Lengths—Flat bar lengths vary among sources from 10 feet to over 20 feet. Most sources can cut lengths to order when required.

Cold Finished Rounds—A very full selection of cold finished round products is widely available. Although round bars under ½″ are technically classified as wire, producers and distributors usually list the bar selection starting at ⅛″. Generally available sizes run up to 6″ in diameter. Increments of size are small—all 1/32's are available through ½″, all 1/16's through 2″, all ⅛'s through 3″ and all ¼'s through 6″. Stock lengths range from 10 feet to over 20 feet.

Cold Finished Hexagons—A good selection of cold drawn annealed hexagon bar is generally available from producers or steel service centers. Widely stocked sizes range from 3/16″ wire sizes through 3″. Most 1/16″ increments are generally stocked through 2″.

Cold Finished Squares—Square cold drawn annealed bar and wire (listed together) are available in sizes 3/16″ through 2″. All 1/16's are stocked through ½″, most ⅛'s through the larger sizes.



TYPES: The round bar sizes as described above are generally available in Types 302, 304 and 316; most sizes are available in all three alloys. A number of sizes are also available in Type 410 as well as some available sizes in Type 430.

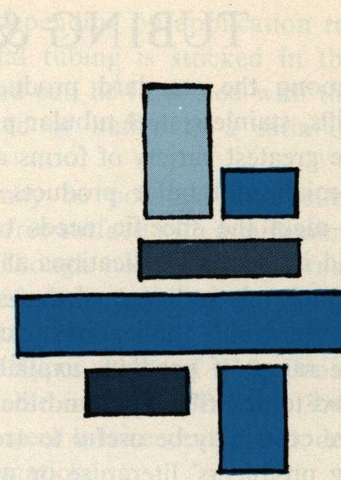
In flat bar stock virtually all sizes are offered in Types 302 and 304. Type 316 is stocked in most thicknesses but not generally in all widths. Availability of Type 316 in hexagonal shapes is excellent —better than for Types 302 and 304 which are not stocked in the wire size range or in most sizes between ¾″ and 1¼″.

Steel service centers or stainless steel producers will provide assistance in finding any particular combination of size and grade required.

FLAT BAR

Weight in Pounds per Lineal Foot

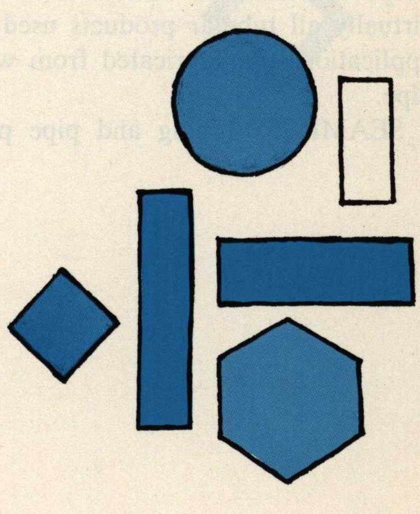
Width, Inches	Thickness 1/8	3/16	1/4	3/8	1/2	5/8	3/4	1
1/2	0.21	0.32	0.42	0.64				
5/8	0.26	0.40	0.53	0.80	1.06			
3/4	0.31	0.48	0.64	0.96	1.27	1.59		
7/8	0.37	0.56	0.74	1.12	1.49	1.86	2.23	
1	0.42	0.64	0.85	1.28	1.70	2.12	2.55	
1 1/4	0.53	0.80	1.06	1.59	2.12	2.65	3.19	4.25
1 1/2	0.63	0.96	1.28	1.92	2.55	3.19	3.83	5.10
1 3/4	0.74	1.15	1.49	2.23	2.98	3.72	4.47	5.95
2	0.85	1.28	1.70	2.55	3.40	4.25	5.10	6.80
2 1/2	1.06	1.59	2.12	3.19	4.25	5.31	6.38	8.50
3	1.28	1.91	2.55	3.83	5.10	6.38	7.65	10.20
3 1/2	1.49	2.23	2.98	4.47	5.95	7.44	8.93	11.90
4		2.46	3.40	5.10	6.80	8.50	10.20	13.60
4 1/2			3.83	5.74	7.65	9.57	11.48	15.30
5			4.25	6.38	8.50	10.63	12.75	17.00
6			5.10	7.65	10.20	12.75	15.30	20.40



ROUND, SQUARE, AND HEXAGONAL BAR

Weight in Pounds per Lineal Foot

Size Inches	Rd	Sq	Hex
1/16	.010	.013	....
1/8	.042	.053	.046
3/16	.094	.120	.103
1/4	.168	.214	.184
5/16	.262	.334	.287
3/8	.378	.481	.414
7/16	.514	.655	.564
1/2	.671	.855	.736
9/16	.850	1.08	.932
5/8	1.05	1.33	1.15
11/16	1.27	1.62	1.39
3/4	1.51	1.92	1.66
13/16	1.77	2.26	1.94
7/8	2.06	2.62	2.25
15/16	2.36	3.01	2.58
1	2.68	3.42	2.94
1 1/16	3.01	3.84	3.32
1 1/8	3.38	4.30	3.73
1 3/16	3.76	4.79	4.15
1 1/4	4.17	5.31	4.60
1 5/16	4.60	5.86	5.07
1 3/8	5.02	6.43	5.57
1 7/16	5.52	7.03	6.08
1 1/2	6.01	7.65	6.62
1 9/16	6.52	8.30	7.19
1 5/8	7.05	8.98	7.77
1 11/16	7.60	9.68	8.38
1 3/4	8.18	10.41	9.02
1 13/16	8.77	11.17	9.67
1 7/8	9.39	11.95	10.35
1 15/16	10.02	12.76	11.05
2	10.68	13.60	11.78



TUBING & PIPE

Among the standard products of the producers' mills, stainless steel tubular products are offered in the greatest variety of forms and properties. Highly specialized tubular products have been developed to meet the specific needs of various ornamental and industrial applications at the lowest cost. Even though relatively few of these products are used for architectural applications, some understanding of the range of products available, the nomenclature used to describe them and their properties and relative costs may be useful to architects when consulting producers' literature or writing specifications.

PRODUCT DESIGNATION: Stainless steel tubular products can be classified either by means of production or by intended end use application.

Classification by means of production—Stainless steel tubing and pipe may be divided into two categories, SEAMLESS and WELDED, by means of production. Generally, thin-walled tubing is most economically produced by welding methods, while thick-walled tubing is most economically produced by seamless processes.

WELDED tubular products are formed from coiled strip and are continuously welded on automatic equipment. Fusion welding by inert gas shielded methods is used to provide pressure-tight seams of maximum strength. High frequency resistance welding is generally used to produce ornamental grade stainless steel tubing at a high production rate. Because of size, wall thickness, shape requirements and economic considerations, virtually all tubular products used in architectural applications are fabricated from welded tubing or pipe.

SEAMLESS tubing and pipe produced by extrusion or rotary piercing of solid billets. Seamless tubing is used primarily for processing industry applications where highly corrosive substances of high temperatures require precise physical and chemical properties. To meet the requirements of various ASTM and user specifications, seamless tubing is normally solution annealed and pressure tested.

Classification by end use or application—A widely used means of classifying stainless steel tubular products is classification by intended end use or application. Among the common end use classifications of stainless steel tubing and pipe are ornamental tubing, mechanical tubing, sanitary tubing, pressure tubing and pipe, aircraft and missile tubing, heat resistant tubing and beverage tubing.

PIPE: The designation "pipe" is applied to round tubular products which are produced in the size and wall thickness increments specified by the American National Standards Institute (formerly the American Standards Association) in ANSI B36.19. Diameter and wall thickness are specified by "schedules." Available sizes in stainless steel for schedules 5S, 10S, 40S and 80S are listed on page 10.

Traditionally, stainless steel pipe has been used in architecture for railings, although nonpressure-tested, ornamental grade tubing in pipe sizes is gaining prominence in this application. A number of stainless steel fittings, such as end caps, elbows, T's and wall returns, are available from several producers in sizes to fit 1¼″ and 1½″ pipe and equivalent size tubing.

TUBING: Tubular products not designated as pipe are classified as tubing. Stainless steel tubing is stocked in round, square, rectangular, hexagonal, true oval and flat oval shapes in a wide range of fractional O.D. sizes, BW gauge wall thickness increments and alloys.

Ornamental grade tubing is the type most frequently used for architectural applications. This tubing is a welded product available in a wide variety of shapes, sizes, gauges and finishes. Because it is not annealed or pressure tested, it is generally the least expensive grade of stainless steel tubing. In addition to architectural applications, it is commonly used for hospital, cafeteria and restaurant equipment, for furniture and for swimming pool accessories.

Outside diameter, wall thickness, straightness and ovality tolerances are lower for ornamental tubing than for mechanical tubing of comparable diameter and wall thickness. The inside weld bead may or may not be removed depending on application requirements. Ornamental tubing is stocked in the as-welded condition and can be furnished with the outside surface polished or buffed to a satin or mirror finish.

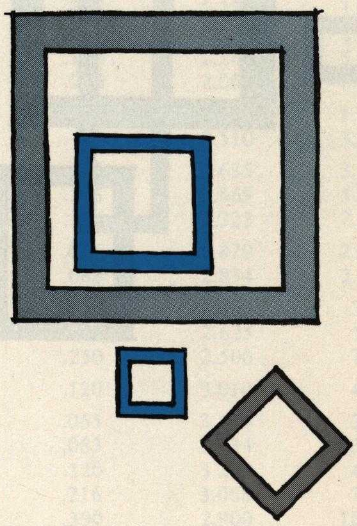
As-welded tubing may be polished to a substantially imperfection-free surface with a minimum removal of material. Though not annealed, ornamental tubing is suitable for most bending operations.

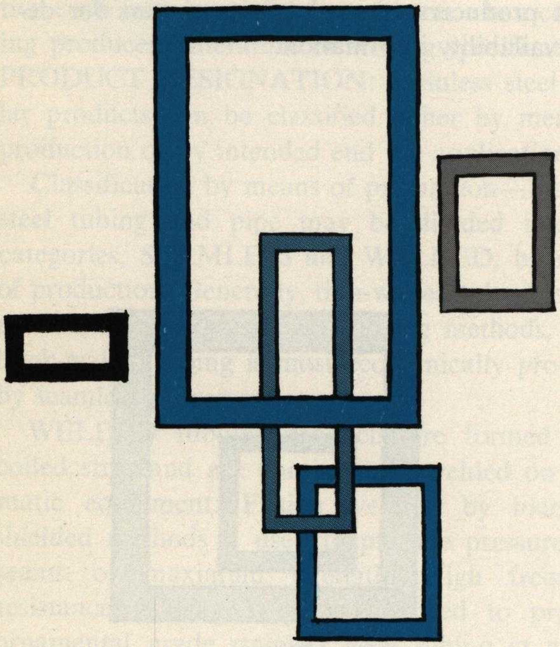
ALLOYS: Stainless steel pipe in all schedules is primarily available in Types 304 and 316. Ornamental tubing is available in Types 302 and 304. Consult producers or steel service centers for detailed availability information.

SQUARE TUBING

Weight in Pounds per Lineal Foot

	Wall Thickness							
BW gauge	20	18	16	14	12	11	10	9
OD, Inches								
½ x ½	.221	.301	.385					
⅝ x ⅝	.281	.384	.495	.612				
¾ x ¾	.340	.467	.606	.753				
⅞ x ⅞	.400	.550	.716	.894				
1 x 1	.459	.634	.827	1.035	1.321	1.436		
1⅛ x 1⅛	.519	.717	.937	1.176	1.506	1.640		
1¼ x 1¼	.578	.800	1.048	1.317	1.691	1.844		
1⅜ x 1⅜	.638	.884	1.158	1.458	1.877	2.048		
1½ x 1½	.697	.967	1.269	1.600	2.062	2.252	2.489	
1¾ x 1¾	.816	1.134	1.490	1.882	2.433	2.660	2.945	
1⅞ x 1⅞	.876	1.217	1.600	2.023	2.618	2.864	3.173	3.476
2 x 2	.935	1.300	1.711	2.164	2.803	3.068	3.401	3.728
2¼ x 2¼		1.467	1.932	2.446	3.174	3.476	3.856	4.231
2½ x 2½			2.153	2.728	3.544	3.884	4.312	4.734
2⅝ x 2⅝			2.263	2.869	3.729	4.088	4.539	4.985
3 x 3			2.595	3.293	4.286	4.700	5.223	5.741
3½ x 3½			3.036	3.857	5.027	5.516	6.134	6.747
4 x 4			3.479	4.422	5.768	6.332	7.045	7.753





RECTANGULAR TUBING

BW gauge / OD, Inches	Wall Thickness 20	18	16	14	12	11	10	9
⅜ x 1	.310	.425						
½ x 1	.340	.467	.606	.753				
½ x 1¼	.400	.550	.716	.894				
½ x 1½	.495	.634	.826	1.035				
⅝ x ¾	.311	.426	.550	.682				
⅝ x 1½	.489	.675	.882	1.106	1.414			
⅝ x 2	.608	.842	1.103	1.388	1.784			
¾ x 1	.400	.550	.716	.894				
¾ x 1¼	.459	.634	.827	1.035				
¾ x 1½	.519	.717	.937	1.176				
¾ x 1¾		.800	1.047	1.317				
¾ x 2	.638	.884	1.158	1.458	1.877	2.048		
⅞ x 1¼	.489	.675	.882	1.106	1.414			
1 x 1⅛	.489	.675	.882	1.106				
1 x 1¼	.519	.717	.937	1.176	1.506	1.640		
1 x 1½	.578	.800	1.048	1.317	1.691	1.844		
1 x 1¾	.638	.884	1.158	1.458	1.877	2.048		
1 x 2	.697	.967	1.269	1.600	2.062	2.252	2.489	
1 x 2½	.816	1.134	1.490	1.882	2.433	2.660	2.945	
1 x 3		1.300	1.711	2.164	2.803	3.068	3.401	
1 x 3½		1.467	1.932	2.446	3.174	3.476	3.856	
1¼ x 1¾	.697	.967	1.269	1.600	2.062	2.252		
1¼ x 2	.757	1.050	1.379	1.741	2.247	2.456		
1¼ x 3		1.383	1.821	2.305	2.989	3.272	3.628	3.979
1¼ x 3½		1.550	2.042	2.587	3.359	3.680	4.084	4.483
1¼ x 4		1.716	2.263	2.869	3.729	4.088	4.539	4.995
1⅜ x 1½		.661	1.213	1.528	1.969	2.150		
1⅜ x 6⅜			3.368	4.280	5.582	6.128	6.817	7.501
1½ x 2	.816	1.134	1.490	1.882	2.433	2.660		
1½ x 2¼		1.217	1.600	2.023	2.618	2.864	3.173	3.476
1½ x 2½		1.300	1.711	2.164	2.803	3.068	3.401	3.728
1½ x 3		1.467	1.932	2.446	3.174	3.476	3.856	4.231
1½ x 3½		1.633	2.153	2.728	3.544	3.884	4.312	
1¾ x 2		1.217	1.600	2.023	2.618	2.864	3.173	3.476
1¾ x 4		1.883	2.484	3.151	4.100	4.496	4.995	5.488
2 x 3		1.633	2.153	2.728	3.544	3.884	4.312	4.734
2 x 4			2.595	3.293	4.286	4.700	5.223	5.741
2 x 5			3.037	3.857	5.027	5.516	6.134	6.747
2½ x 3			2.374	3.011	3.915	4.292	4.767	5.237
2½ x 4			2.816	3.575	4.656	5.108	5.679	6.244
2½ x 5			3.258	4.139	5.397	5.924	6.590	7.250
3 x 3½			2.816	3.575	4.656	5.108	5.679	6.244
3 x 4 (indented)			3.037	3.857	5.027	5.516	6.134	6.747
3 x 4			3.037	3.857	5.027	5.516	6.134	6.747
3 x 5			3.479	4.422	5.768	6.332	7.045	7.753

Approximate Weight/Pounds per lineal foot — Indicated in each column
(Weights are based on formula using density of carbon steel)
All sizes available in types 302 and 304

ROUND TUBING

OD, Inches	Wall Thickness B.W. Ga.	Wall Thickness Dec. Equiv.	ID, Inches	Pounds per Foot
1/8	x 22	.028	.069	.0290
3/16	x 22	.028	.131	.0478
	20	.035	.117	.0572
1/4	x 22	.028	.194	.0664
	20	.035	.180	.0804
	18	.049	.152	.1052
	16	.065	.120	.1284
5/16	x 20	.035	.242	.1039
	18	.049	.214	.1382
	16	.065	.182	.1722
3/8	x 22	.028	.319	.1038
	20	.035	.305	.1271
	18	.049	.277	.1706
	16	.065	.245	.2152
7/16	x 20	.035	.367	.1506
	18	.049	.339	.2036
	16	.065	.307	.2589
1/2	x 20	.035	.430	.1738
	18	.049	.402	.2360
	16	.065	.370	.3020
	13	.095	.310	.4109
	11	.120	.260	.4870
5/8	x 20	.035	.555	.2205
	18	.049	.527	.3014
	16	.065	.495	.3888
	11	.180	.385	.6472
3/4	x 20	.035	.680	.2673
	18	.049	.652	.3668
	16	.065	.620	.4755
	14	.083	.584	.5913
	13	.095	.560	.6646
	11	.120	.510	.8074
7/8	x 20	.035	.805	.3140
	18	.049	.777	.4323
	16	.065	.745	.5623
	11	.120	.635	.9676
1	x 20	.035	.930	.3607
	18	.049	.902	.4977
	16	.065	.870	.6491
	14	.083	.834	.8129
	13	.095	.810	.9182
	11	.120	.760	1.128
	3/16	.187	.625	1.630
	1/4	.250	.500	2.003
1 1/4	x 20	.035	1.180	.4542
	16	.065	1.120	.8226
	14	.083	1.084	1.034
	11	.120	1.010	1.448
	3/16	.187	.875	2.132
	1/4	.250	.750	2.670
1 3/8	x 16	.065	1.245	.9094
1 1/2	x 20	.035	1.430	.5476
	18	.049	1.402	.7593
	16	.065	1.370	.9962
	14	.083	1.334	1.256
	11	.120	1.260	1.769
	3/16	.187	1.125	2.634
	1/4	.250	1.000	3.338
1 5/8	x 16	.065	1.495	1.083

OD, Inches	Wall Thickness B.W. Ga.	Wall Thickness Dec. Equiv.	ID, Inches	Pounds per Foot
1 3/4	x 18	.049	1.652	.8902
	16	.065	1.620	1.170
	14	.083	1.584	1.478
	11	.120	1.510	2.089
	3/16	.187	1.375	3.136
1 7/8	x 13	.095	1.685	1.806
2	x 20	.035	1.930	.7345
	18	.049	1.902	1.021
	16	.065	1.870	1.343
	14	.083	1.834	1.699
	11	.120	1.760	2.409
	3/16	.187	1.625	3.638
	1/4	.250	1.500	4.673
2 1/4	x 16	.025	2.120	1.517
	11	.120	2.010	2.730
	3/16	.187	1.875	4.140
	1/4	.250	1.750	5.340
2 3/8	x 16	.065	2.245	1.604
	12	.109	2.157	2.638
	.154	.154	2.067	3.653
	.218	.218	1.939	5.022
2 1/2	x 18	.049	2.402	1.283
	16	.065	2.370	1.690
	14	.083	2.334	2.143
	11	.120	2.260	3.050
	1/4	.250	2.000	6.008
2 3/4	x 16	.065	2.620	1.864
	11	.120	2.510	3.371
2 7/8	x 11	.120	2.635	3.531
	.203	.203	2.469	5.793
	.276	.276	2.323	7.661
3	x 16	.065	2.870	2.037
	14	.083	2.834	2.586
3	11	.120	2.760	3.691
	3/16	.187	2.625	5.646
	1/4	.250	2.500	7.343
3 1/4	x 11	.120	3.010	4.011
3 1/2	x 16	.065	3.370	2.385
	14	.083	3.334	3.029
	11	.120	3.260	4.332
	.216	.216	3.068	7.576
	.300	.300	2.900	10.25
3 3/4	x 11	.120	3.510	4.652
4	x 16	.065	3.870	2.732
	14	.083	3.834	3.472
	11	.120	3.760	4.973
	3/16	.187	3.625	7.654
	.226	.226	3.548	9.109
	.318	.318	3.364	12.51
4 1/2	x 11	.120	4.260	5.613
	.237	.237	4.026	10.79
	.337	.337	3.826	14.98
5 9/16	x .258	.258	5.047	14.62
	3/8	.375	4.813	20.78
6 5/8	x .280	.280	6.065	18.97
	.432	.432	5.761	28.57
8 5/8	x .322	.322	7.981	28.55
	1/2	.500	7.625	43.49

IRON PIPE SIZES

Iron Pipe Size, In.	Pounds per Foot	Diameter, In. OD	Diameter, In. ID	Wall Thick., Inches
SCHEDULE 5 LIGHT WALL IRON PIPE SIZES				
¾	.684	1.050	.920	.065
1	.868	1.315	1.185	.065
1¼	1.107	1.660	1.530	.065
1½	1.274	1.900	1.770	.065
2	1.604	2.373	2.245	.065
2½	2.475	2.875	2.709	.083
3	3.029	3.500	3.334	.083
3½	3.505	4.000	3.834	.083
4	3.195	4.500	4.334	.083
6	7.585	6.625	6.407	.109
8	9.914	8.625	8.407	.109
SCHEDULE 10 LIGHT WALL IRON PIPE SIZES				
½	.671	.840	.674	.083
¾	.857	1.050	0.884	.083
1	1.404	1.315	1.097	.109
1¼	1.806	1.660	1.442	.109
1½	2.085	1.900	1.682	.109
2	2.638	2.375	2.157	.109
2½	3.531	2.875	2.635	.120
3	4.332	3.500	3.260	.120
3½	4.973	4.000	3.760	.120
4	5.613	4.500	4.260	.120
6	.929	6.625	6.357	.134
8	13.40	8.625	8.329	.148
10	18.65	10.750	10.420	.165
SCHEDULE 40 STANDARD IRON PIPE SIZES				
⅛	.245	.405	.269	.068
¼	.425	.540	.364	.088
⅜	.568	.675	.493	.091
½	.851	.840	.622	.109
¾	1.131	1.050	.824	.113
1	1.679	1.315	1.049	.133
1¼	2.273	1.660	1.380	.140
1½	2.718	1.900	1.610	.145
2	3.653	2.375	2.067	.154
2½	5.790	2.875	2.469	.203
3	7.580	3.500	3.068	.216
3½	9.109	4.000	3.548	.226
4	10.790	4.500	4.026	.237
5	14.620	5.563	5.047	.258
6	18.970	6.625	6.065	.280
8	28.550	8.625	7.981	.322
SCHEDULE 80 EXTRA HEAVY IRON PIPE SIZES				
⅛	.315	.405	.215	.095
¼	.535	.540	.302	.119
⅜	.739	.675	.423	.126
½	1.088	.840	.546	.147
¾	1.474	1.050	.742	.154
1	2.172	1.315	.957	.179
1¼	2.997	1.660	1.278	.191
1½	3.631	1.900	1.500	.200
2	5.022	2⅜	1.939	.218
2½	7.661	2⅞	2.323	.276
3	10.250	3½	2.900	.300
3½	12.510	4.000	3.364	.318
4	14.980	4.500	3.826	.337
5	20.780	5.563	4.813	.375
6	28.570	6.625	5.761	.432
8	43.490	8.625	7.625	.500

WIRE & WIRE CLOTH

PRODUCT DESIGNATION: Cold finished products ½″ and under in round or square, hexagon, octagon, half-round, oval, and other sections identified by a single dimension are referred to respectively as round or shape wire. Cold finished products 0.01″ to under 3/16″ thick and 1/16″ to under ⅜″ wide are designated as flat wire.

AVAILABILITY AND TYPES: Most wire sizes and shapes commonly used in architecture are included in the cold finished bar stock listings on page 5. Sizes in this listing range upward from ⅛″.

Coils—Coiled round wire, sized in decimals, is stocked in Types 302 and 316. Readily available sizes range from .007″ through .420″. Coils in Type 430 are listed in sizes .091″ through .220″.

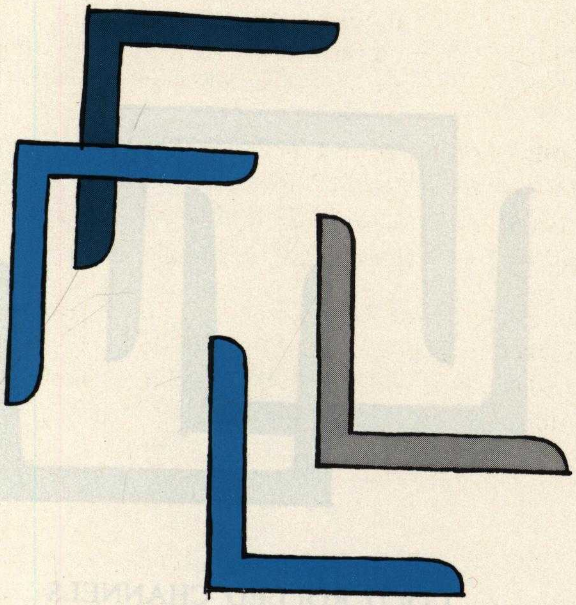
Wire Cloth—Rolls of wire cloth and screening are stocked in Types 304 and 316 stainless steel. Typical availability in rolls 36″ wide is shown in the table below.

WIRE CLOTH

Mesh	Wire Size, Inches	Width of Opening, Inches	Percentage of Open Area
4 x 4	.047	.203	65.9
4 x 4	.035	.215	74.0
5 x 5	.035	.165	68.1
5 x 5	.023	.177	78.3
8 x 8	.032	.093	55.4
8 x 8	.028	.097	60.2
8 x 8	.025	.100	64.0
10 x 10	.032	.068	46.2
10 x 10	.025	.075	56.3
10 x 10	.023	.077	59.3
12 x 12	.023	.060	51.8
12 x 12	.018	.065	60.8
16 x 16	.018	.045	50.7
20 x 20	.016	.034	46.2
24 x 24	.014	.028	44.2
30 x 30	.017	.016	23.9
30 x 30	.012	.021	40.8
40 x 40	.010	.015	36.0
50 x 40	.009	.011	31.7
60 x 50	.0065	.010	39.4
60 x 60	.011	.006	11.7
80 x 70	.0055	.007	34.5
100 x 90	.0045	.006	33.0
150 x 150	.0026	.0041	37.4
180 x 180	.0025	.0031	30.6
200 x 200	.0021	.0029	33.6
325 x 325	.0014	.0017	30.0
400 x 400	.0010	.0015	36.0

ROLLED & EXTRUDED STRUCTURALS

PRODUCT DESIGNATION: Angles, channels, Tees, I beams, and H beams are produced in stainless steel. Precisely speaking, shapes are "Structural" when at least one cross-sectional dimension is 3″ or larger; smaller shapes are referred to as "bar size shapes."



AVAILABILITY: The following tables of dimensions and weights list the generally available structural shapes popular for architectural applications. Random lengths of about 20 feet are generally standard. Steel service centers stock primarily the hot rolled and extruded equal-leg angles listed in the table on page 12. Other extruded structural shapes are readily produced to order by mills or fabricators with extrusion presses. Cold rolled angles and channels are stocked by suppliers of architectural metal components. For assistance in locating any item, contact a stainless steel producer of rolled or extruded products or a steel service center.

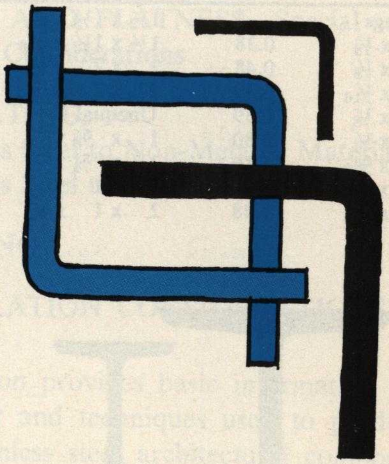
TYPES: Hot rolled equal-leg angles, as shown, are widely available in Types 302, 304 and 316. Extruded equal-leg angles are stocked in Types 304 and 316. The other structural shapes are available primarily in Type 304.

FINISHES: Stainless steel T's and beams are produced by extrusion only; channels and angles are produced by extrusion, hot rolling or cold rolling.

Extrusions—Extruded structurals characteristically have rounded outside and inside corners and edges and have flat surfaces. However, some channels, tees, and beams are produced to match the profile of standard hot rolled sections, which are tapered.

The following limitations, subject to variation among extruders, generally apply to extruded structural shapes: The maximum diameter of the smallest circle that will circumscribe the cross section of the shape is 6″. Straight lengths up to 60 feet can be produced. Lengths up to 28 feet can be deglassed and heat treated. (Molten glass is used as a lubricant in extruding stainless steel.) The depth of an indentation can be no greater than its width. Minimum web thickness is approximately 0.125″, varying slightly with the alloy. See page 9 of the Fabrication section for more detailed information concerning extrusion limitations.

Hot Rolled Shapes—These are characterized by sharp, short-radius outside corners and flat outside surfaces, along with rounded inside corners and surfaces. Inside surfaces of angles taper to give a thicker section at the bend than near the edges; on channels, the middle or web section is flat on both sides, the flanges rounded and tapered on the inner side. Hot rolled shapes should be specified as annealed and pickled.



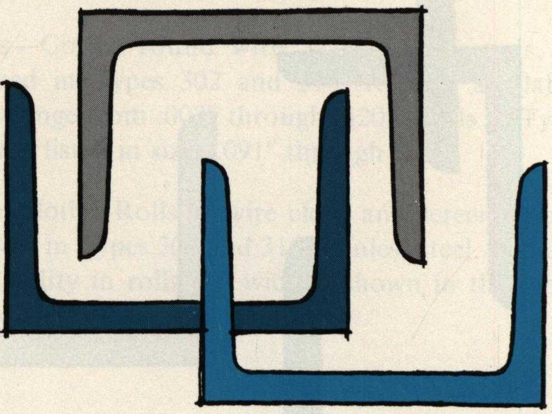
Cold Rolled Shapes—Cold rolled angles and channels are produced by bending cold rolled stainless steel sheet. The resulting section has rounded outside corners, sharp inside corners, flat surfaces, and square edges. The smooth rolled finish is suitable for polishing.

ANGLES
Extruded

Size, Inches	Pounds per Foot	Size, Inches	Pounds per Foot
Unequal Leg		Equal Leg	
a b c		a b c	
2 x 1 x 3/16	1.75	1 x 1 x 3/16	1.15
2 x 1½ x 3/16	2.12	1¼ x 1¼ x 3/16	1.48
2½ x 2 x 3/16	2.75	1½ x 1½ x 3/16	1.80
3 x 2 x 3/16	3.07	1¾ x 1¾ x 3/16	2.12
		2 x 2 x 3/16	2.44
2 x 1 x ¼	2.35	2½ x 2½ x 3/16	3.07
2 x 1½ x ¼	2.78	3 x 3 x 3/16	3.71
2½ x 1¼ x ¼	2.85		
2½ x 1½ x ¼	3.19	1 x 1 x ¼	1.49
2½ x 2 x ¼	3.62	1¼ x 1¼ x ¼	1.92
3 x 1½ x ¼	3.51	1½ x 1½ x ¼	2.38
3 x 2 x ¼	4.10	1¾ x 1¾ x ¼	2.75
3½ x 2½ x ¼	4.90	2 x 2 x ¼	3.19
3½ x 3 x ¼	5.40	2½ x 2½ x ¼	4.10
4 x 3 x ¼	5.80	3 x 3 x ¼	4.90
		3½ x 3½ x ¼	5.80
2½ x 1½ x ⅜	4.70		
2½ x 2 x ⅜	5.30	2 x 2 x 5/16	3.92
3 x 1½ x ⅜	5.30	2½ x 2½ x 5/16	5.00
3 x 2 x ⅜	5.90	3 x 3 x 5/16	6.10
3½ x 2½ x ⅜	7.23		
3½ x 3 x ⅜	7.90	2 x 2 x ⅜	4.70
4 x 3 x ⅜	8.50	2½ x 2½ x ⅜	5.90
		3 x 3 x ⅜	7.20
3 x 1 x ½	6.01	3½ x 3½ x ⅜	8.50
3 x 2 x ½	7.70		
3½ x 1½ x ½	7.64	3 x 3 x ½	9.40
3½ x 3 x ½	10.20	3½ x 3½ x ½	11.10
4 x 3 x ½	11.10		

CHANNELS
Hot Rolled (Annealed and Pickled) & Extruded

Size, Inches	Pounds per Foot	Size, Inches	Pounds per Foot
1 x ½ x ⅛	0.75	1½ x 1 x ¼	2.57
1½ x ½ x ⅛	0.96	2 x ⅝ x ¼	2.35
2½ x ⅝ x 3/16	2.28	2 x 1 x ¼	3.15
1½ x ¾ x 3/16	1.75	2½ x 1 x ¼	3.57
2 x ¾ x 3/16	2.02	3 x 1½ x ¼	4.75
3 x 1⅜ x 3/16	4.10	4 x 1¾ x ¼	6.69
1¼ x 1 x ¼	2.35		

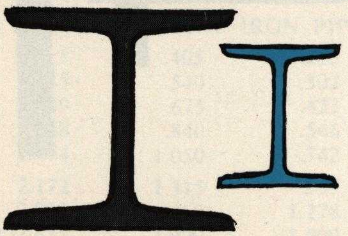


COLD ROLLED ANGLES
Square Root and Square Edge

Size, Inches	Pounds per Foot	Size, Inches	Pounds per Foot
Equal Legs		1½ x 1½ x ⅛	1.23
½ x ½ x ⅛	0.38	1½ x 1½ x 3/16	1.80
⅝ x ⅝ x ⅛	0.48	2 x 2 x ⅛	1.65
¾ x ¾ x 1/16	0.39	2 x 2 x 3/16	2.44
¾ x ¾ x ⅛	0.59	Unequal Legs	
1 x 1 x ⅛	0.80	1 x ⅝ x ⅛	0.64
1 x 1 x 3/16	1.16	1¼ x ¾ x ⅛	0.80
1¼ x 1¼ x ⅛	1.01	1½ x 1 x ⅛	1.01
1¼ x 1¼ x 3/16	1.48	2 x 1 x ⅛	1.23

COLD ROLLED CHANNELS
Square Root and Square Edge

Size, Inches	Pounds per Foot	Size, Inches	Pounds per Foot
Equal Sides		Unequal Sides	
a b c		a b c	
½ x ½ x .093	0.40	⅝ x 5/16 x .078	0.29
¾ x ¾ x .093	0.57	¾ x ⅜ x .083	0:40
1 x 1 x .109	1.03	1½ x 1 x .109	1.22
1¼ x 1¼ x .109	1.32	1¾ x 1⅛ x .109	1.40
1½ x 1½ x .109	1.59	2 x 1 x .125	1.59
2 x 2 x .125	2.41	2⅜ x 2 3/16 x .156	3.41



"I" BEAMS
Extruded

Size, Inches	Pounds per Foot	Size, Inches	Pounds per Foot
1½ x 1 x 3/16	2.02	3 x 2⅜ x ¼	6.60
2 x 1¼ x ¼	3.43	4 x 2¾ x ¼	8.32
2½ x 1½ x ¼	4.22		

"T's"
Extruded

Size, Inches	Pounds per Foot	Size, Inches	Pounds per Foot
1 x 1½ x 3/16	1.48	1½ x 2½ x ¼	3.19
1¼ x 1¼ x 3/16	1.48	2 x 1½ x ¼	2.75
2 x 1¼ x 3/16	1.96	2 x 2 x ¼	3.19
1½ x 1½ x 3/16	1.65	2½ x 2½ x ¼	4.10
2⅜ x 1½ x 3/16	2.36	2½ x 2½ x ⅜	5.90
1¼ x 1 x ¼	1.71	3 x 2½ x ⅜	6.70
1¼ x 2 x ¼	2.57	4 x 3½ x 5/16	7.66

Fabrication and Joining

This section provides basic information about the equipment and techniques used to produce fabricated stainless steel architectural components and assemblies. A basic explanation of the operation of fabricating equipment is presented, and general practical dimensional limitations for the various fabricating methods, such as maximum gauge and minimum bending radii, are established where applicable. In addition, methods of fastening and joining components for use in architectural applications are discussed and detailed.

CUTTING

For architectural applications stainless steel is normally cut to size by shearing, sawing, abrasive cutting, blanking, perforating or nibbling.

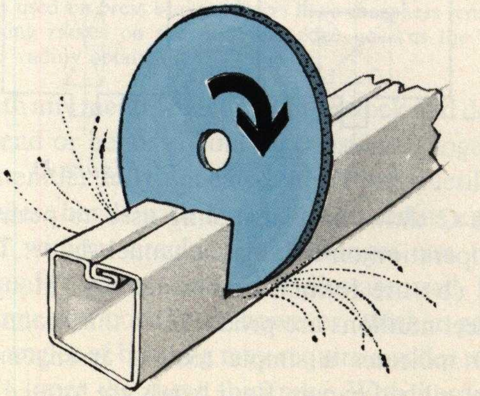
SHEARING: Shearing is the fastest method for obtaining straight cuts of coil, sheet, and light plate stock. It is accomplished on the same equipment used for carbon steel. Because of the toughness of stainless steel, however, the equipment capacity required in relation to thickness of the material is from 30 to 50 percent greater.

To insure clean cuts, blades of high-speed steel are maintained sharp and are set with minimum clearance. Hold-downs are needed in shearing stainless steel. To protect prefinished material, a thickness of paper, tape, or other padding is used under the work and under the hold-downs.

Contoured cuts can be made using rotary shears, which utilize opposing cutting discs to make cuts of constant or varying radii.

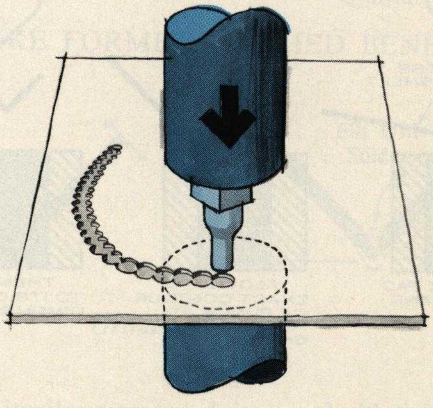
SAWING: In general, sawing techniques apply to bar stock, to tubing, to cuts across narrow widths of sheet or coil stock, and to trimming. Conventional hack saws, band saws, and friction saws are used, with blades recommended by the manufacturers.

Conventional band saw cutting is done with a sharp blade operated at slow speed and with a light, steady rate of feed. In friction sawing, the band saw blade travels at extremely high speed (5,000-15,000 fpm), creating sufficient heat to soften the metal for easier removal. This technique produces considerably quicker cutting, and the sharpness of the blade is less critical than with other methods. Conventional sawing may prove more efficient, however, where flat pieces can be stacked and sawed several at a time. A limited degree of contour cutting can be done on the band saw operated at either conventional or friction-sawing speed.



ABRASIVE CUTTING: Excellent production cutting results are obtained with abrasive wheels or cutoff discs of various diameters used like circular saw blades. These make fast, smooth, accurate cuts in virtually all architectural stainless steel shapes and are especially effective for cutting off roll formed components. Unlike the band saw, the disc can be used to make a slot or groove without cutting all the way through a piece of tubing or plate. Proper use of coolant precludes risk of heat damage to the material. Only straight cuts can be made.

BLANKING, NIBBLING, PUNCHING: Notches or openings of any shape may be punched out of stainless steel stock with blanking or nibbling equipment of the same type used with carbon steel. With austenitic grades, about 50 percent more power is required for a given operation. Cuts are made at reduced speed, with the punch traveling all the way through. Nibbling is a specialized operation in which a line of small overlapping holes is punched to cut irregular shapes from sheet metal. Nibbling machines handle austenitic grades of steel in thicknesses up to and including 5/16″. In perforating or punching holes in austenitic stainless, the same power ratio is required as in blanking and nibbling. It should be remembered, however, that the minimum diameter of the hole should be at least twice the thickness of the metal. Various nibbling die shapes are available to provide optimum combinations of speed and smoothness of cut under various conditions. Nibbling makes it practical for the architect to design shapes not suitable for cutting on the band saw.

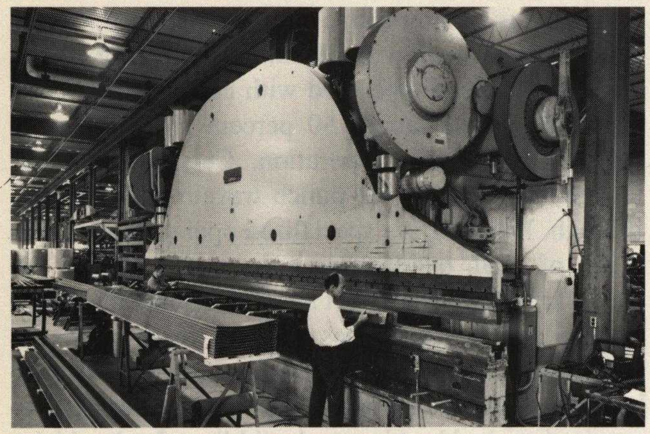


DRILLING: Holes of virtually all sizes are drilled in stainless steel with sharp, high-speed steel drills. Grooved or high-helical drills are sometimes preferred to provide easy chip clearance since austenitic steels are more "stringy" than carbon steel. Especially with light gauges, a back-up block of soft steel or cast iron helps prevent burring.

BRAKE FORMING

Press brakes are the means most commonly used to produce specified bends for architectural applications. Lineal architectural shapes such as mullions, column covers, door and window components and ribbed siding panels may be easily and economically fabricated on a forming brake with few limitations.

Most fabricating shops have power operated press brakes with a capacity to bend stainless sheet up to ⅛″ thick in lengths up to 12 feet. Although austenitic stainless grades require about twice as much



power for forming bends as low carbon steel in equivalent thicknesses, most available brakes can handle the range of gauges normally used in architecture. Some manufacturers have larger brakes up to 40 feet in length to produce steel roof and floor deck, industrial siding, lightpoles and so forth. This equip-

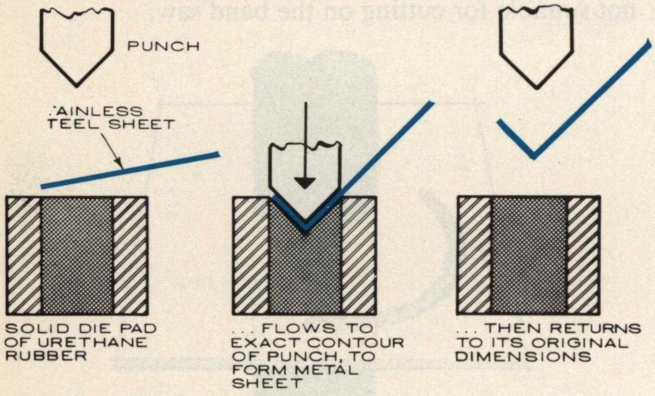


Figure A

ment is suitable for special custom applications such as long mullions and column covers.

Press brakes are especially economical for forming bends in components for small jobs inasmuch as they can use low-cost or general purpose dies. For larger productions press brakes may also be economical if the components do not require too many handling and forming operations in order to produce the required shape. The number of handlings may sometimes be reduced by combining several bends into one operation through the use of offset or special dies. Where the shape is complicated and does not adapt to combining bends, the roll forming process should be considered for the economical production of large quantities.

A power brake has a great deal of versatility beyond the usual operations of producing simple bends using standard tooling. Special tooling and new methods can reduce cost and improve products. For example, Figure A shows how abrasion-resistant urethane rubber is used for female dies. The male die depresses the metal sheet into the rubber, which deforms, forcing the metal over the die contour. Shapes of various thickness and angularity can be formed using the same female die, and more im-

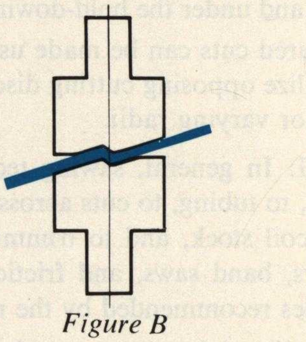


Figure B

portant, the surface in contact with the rubber is not marred by the die. This eliminates the necessity for protective coatings usually required with steel female dies. Figure B shows special brake dies designed to make offsets or joggles in one operation.

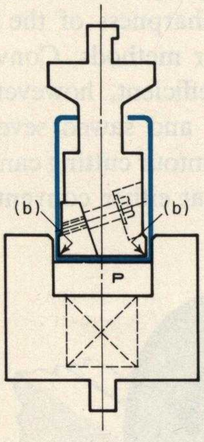


Figure C

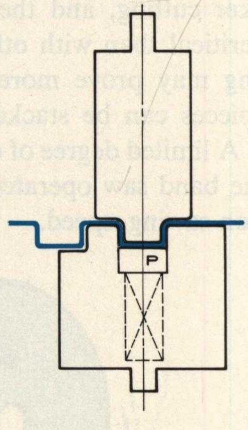


Figure D

Figure C shows special tooling used to perform the final operation on a flanged channel shape. The two bends (b) are formed simultaneously. Many stainless steel mullions are produced in this manner. Figure D indicates a simple tooling arrangement for making ribbed panels. Four bends are formed at each

stroke as the sheet is fed through the press. A rocker brake die for forming flanged channel sections is shown at bottom of stroke in Figure E. This die overbends the part to compensate for the springback which is characteristic of austenitic stainless steels, and permits "hat sections" to be formed in a single press brake operation. Figure F shows the completed formed section prior to being lifted directly from the open rocker die.

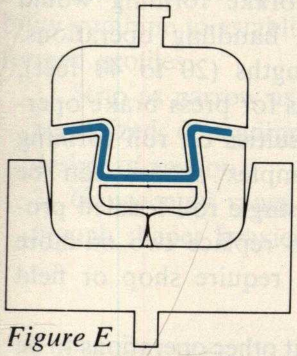


Figure E

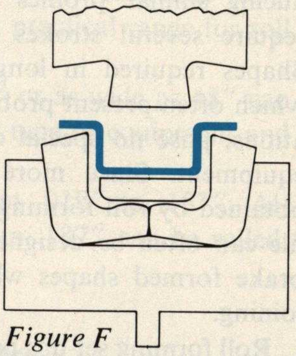


Figure F

Since austenitic steels tend to work-harden in the bend, some problem exists in maintaining close tolerances in flat planes between separate bends. However, brake press dies making simultaneous bends work a wider surface area together and are highly successful in maintaining flatness. Brake capacity should be considered in multiple bend forming as the power requirements are substantially higher than in single bend operations. The following table expresses minimum bend radii in terms of thickness for the various tempers of austenitic stainless steels.

MINIMUM BEND RADII FOR AUSTENITIC STEELS

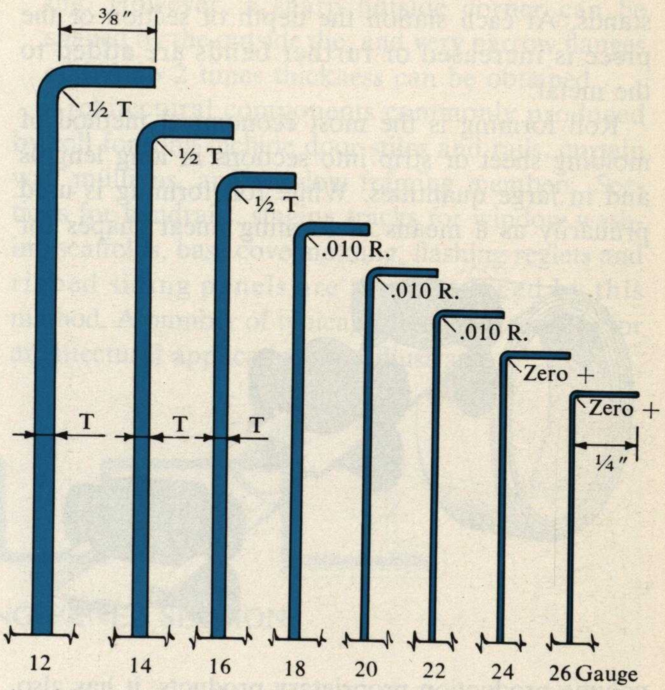
Annealed	0*—1½T
¼ Hard	1—2T
½ Hard	2½—4T
Full Hard	4—6T

T—Metal thickness

*Male dies used on press brakes always have sharpness removed. The existing radius on the male die edge governs the inside minimum radius obtainable.

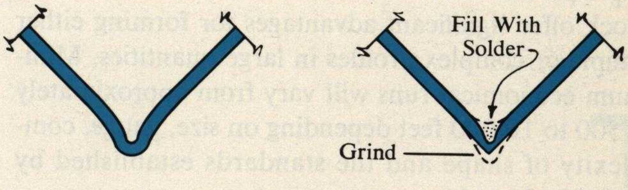
As with any metal, selection of the stock and design of the bend or bends should be considered together. The austenitic, fully-annealed steels are ductile; in thin gauges, bends with a zero inside radius can be obtained without cracking, and flanges can be as narrow as ¼″ when standard V-dies are used. Even in the annealed condition, however, thicker gauges or acute angles of bending may require a wider radius up to 1½ times the sheet thickness. With hardened, tempered stainless steels, (not generally used in architecture) radii up to six times thickness and flanges up to ⅜″ wide will be needed. In case of doubt, test bends should be made.

90° BENDS ANNEALED STAINLESS STEEL

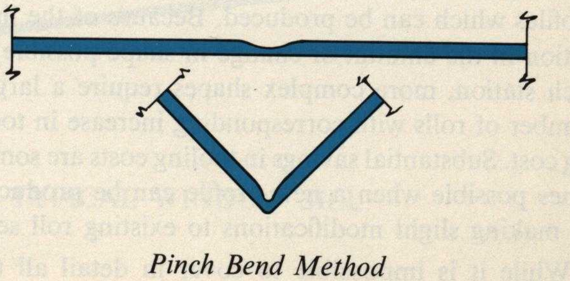


A wide inside radius, of course, produces a rounded outside corner. Corners can be sharpened by pinch-bending or by grinding, but both of these procedures reduce corner strength and increase cost. Where only the outside of a corner is to be exposed, it can be restrengthened with a bead of solder, laid along the inside.

BRAKE FORMED PINCHED BENDS



Grinding Method

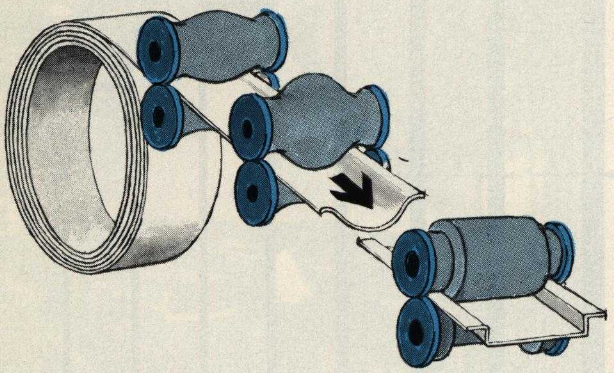


Pinch Bend Method

ROLL FORMING

Roll forming is a process for producing linear shapes by passing sheet stock through a series of power driven, progressively contoured, mating rolls which are mounted in tandem at successive stations or stands. At each station the depth of section of the piece is increased or further bends are added to the metal.

Roll forming is the most economical method of molding sheet or strip into sections in long lengths and in large quantities. While roll forming is used primarily as a means of forming linear shapes for



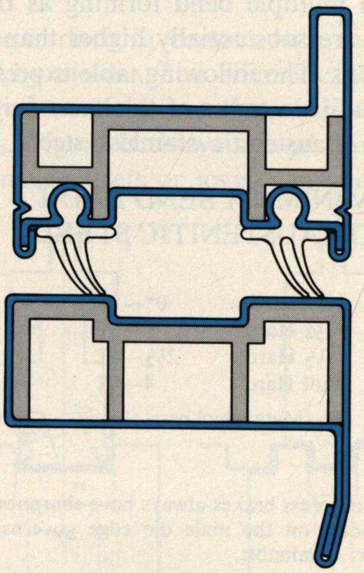
volume production proprietary products, it has also been applied successfully to forming custom linear shapes for a variety of architectural applications. A great range of shapes, including complex profiles can be attained with accuracy.

While brake forming is the method most commonly used for producing linear architectural shapes from sheet stock, roll forming offers a number of advantages which can result in substantial savings in cost. Although tooling costs are generally expensive, rapid production rates and the use of economical coil stock offer significant advantages for forming either simple or complex profiles in large quantities. Minimum economical runs will vary from approximately 3,500 to 10,000 feet depending on size, gauge, complexity of shape and the standards established by individual producers.

The number and spacing of stands on the roll forming machine determine the complexity of the profiles which can be produced. Because of the limitation in the amount of change in shape possible at each station, more complex shapes require a larger number of rolls with corresponding increase in tooling cost. Substantial savings in tooling costs are sometimes possible when a new profile can be produced by making slight modifications to existing roll sets.

While it is impossible to cover in detail all the factors which determine the relative economies between roll forming and brake forming, a number of useful guidelines can be considered. Since tooling costs for roll forming are often a major expense, relatively large production runs are necessary to yield unit costs competitive with or lower than brake forming unit costs. Since roll forming is a continuous forming process, the multiple bends in complex profiles are formed virtually simultaneously. Producing similar profiles by brake forming would require several strokes and handling operations. Shapes required in long lengths (20 to 40 feet), which often present problems for press brake operations, pose no special difficulties on roll forming equipment. Since more complex shapes can be obtained by roll forming, a single roll formed profile can often be designed to replace two or more brake formed shapes which require shop or field joining.

Roll forming set-ups permit other operations to be synchronized with the forming operation. These include spot and seam welding, notching, perforating and cutting to length. In many cases, these additional operations can be performed automatically at the normal forming speed without additional labor. Shapes can also be produced in multiples, rolling one



Stainless steel outer shape is combined with extruded aluminum core to produce the section above. Both materials contribute to strength and stiffness.

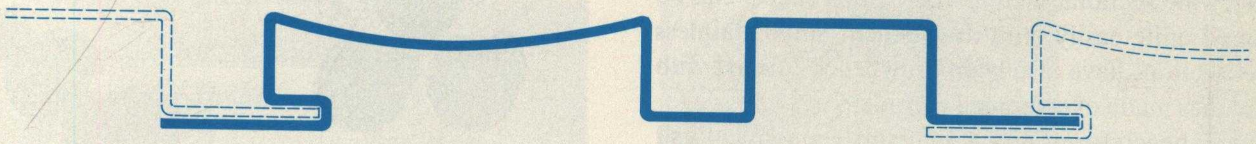
shape onto another or applying stainless steel as a veneer on a carbon steel or extruded aluminum core. Since producer capabilities and relative economies are determined by individual conditions and new techniques are being developed continually, it is advisable to consult with producers whenever the

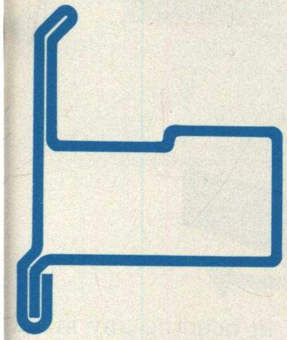
production of linear shapes by roll forming is being considered.

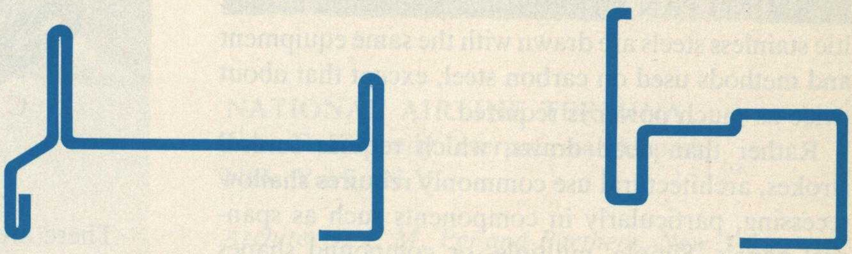
The range of gauge and size for sections produced on various roll forming equipment is extensive. The limitations listed below are approximate, and represent the size and gauge range of roll formed profiles most commonly produced and for which equipment is readily available. While profiles exceeding the limitations stated can be produced, lack of demand, available equipment, and economic feasibility combine to establish a practical range for roll formed profiles.

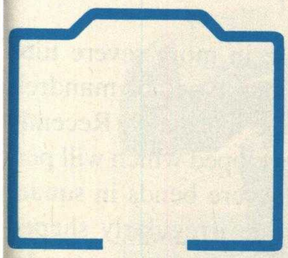
1. Strip as narrow as ¾″ or as wide as 48″ can be utilized, depending on type of equipment and design of section.
2. Gauge may range from .010″ to .187″. Although shapes heavier than .187″ can be rolled, thicknesses greater than .140″ (10-gauge) are not often roll formed in stainless steel.
3. The depth of formed sections can vary up to 6-7½″.
4. Inside radius limitations for roll forming are approximately the same as for press brake bending. However, a sharp outside corner can be shaped by the outside die, and very narrow flanges of 1½ to 2 times thickness can be obtained.

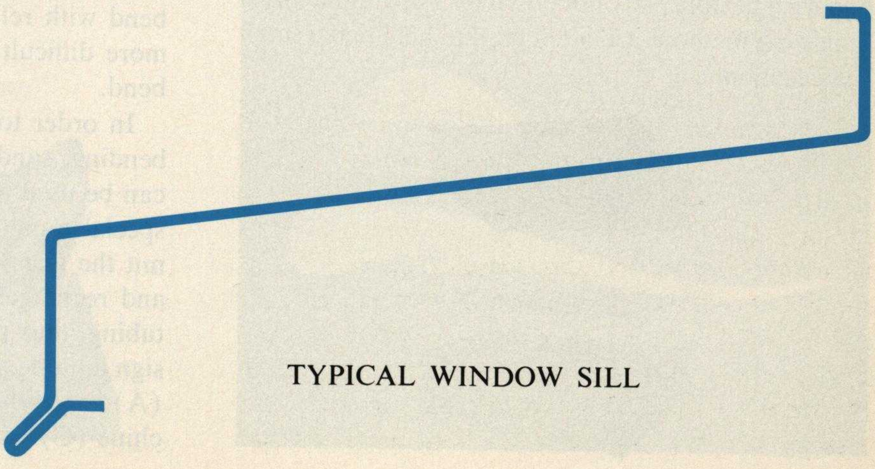
Architectural components commonly produced by roll forming include door stiles and rails, curtain wall mullions, and window framing members. Sections for handrails, staging tracks for window washing scaffolds, base cove molding, flashing reglets and ribbed siding panels are also produced by this method. A number of typical roll formed sections for architectural applications are illustrated.


TYPICAL INTERLOCKING PANEL SECTION


TYPICAL WINDOW SECTION (closed)


TYPICAL WINDOW SECTIONS (open)


TYPICAL WINDOW WASHING TRACK


TYPICAL WINDOW SILL

OTHER FORMING & BENDING METHODS

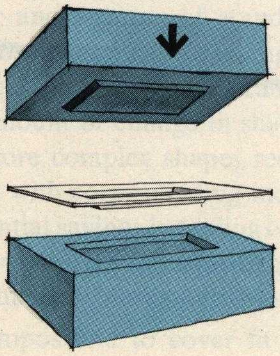
DRAWBENCH FORMING: This process is used to form lineal shapes and resembles roll forming in that the section is shaped by passing through a series of mating pairs of rolls. In drawbench forming, however, the rolls are not driven as they are in roll forming. The force required to pull the part through the rolls is provided by a draw head, which grips the end of the part. The length of the part formed in a single operation is limited by the length of the draw head stroke, which is usually about 100 feet.

Design of rolls and forming procedure is less critical than for roll forming. Since no driving force is transmitted to the material by the rolls, clearances are not critical and pressures may be kept at a minimum. Very wide sections such as corrugated sheets can be formed quite easily on a drawbench. Small stainless steel sections have also been drawbench formed with solid dies made of cemented carbide.

Drawbench forming is a relatively economical and flexible method of producing a variety of shapes in small quantities because of simplified tooling and the ease with which rolls may be changed.

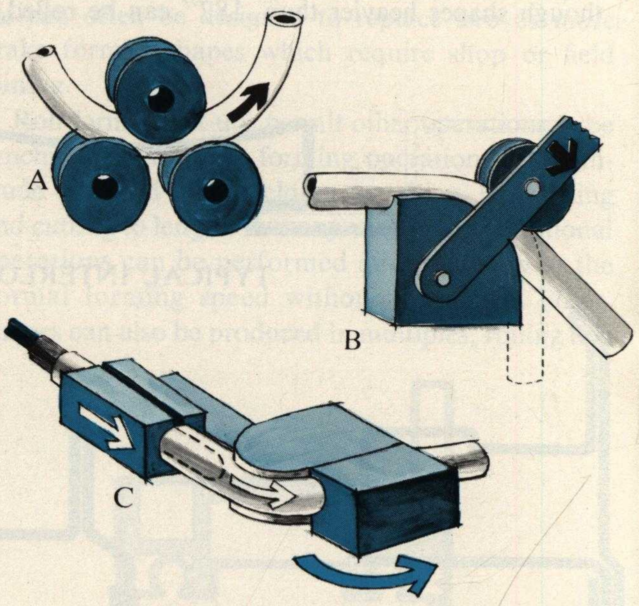
FORMING PAN SHAPES: Fully annealed austenitic stainless steels are drawn with the same equipment and methods used on carbon steel, except that about twice as much power is required.

Rather than deep draws, which require several strokes, architectural use commonly requires shallow recessing, particularly in components such as spandrel panels. Simple, multiple, or compound shapes can be produced by one press stroke with a single set of dies. Matching tooled male and female dies are used for relatively intricate shapes. Less complicated shapes can be produced with one die working against a flexible pad or opposed by a hydraulic force. Single die methods are often used to help make small runs economical.



ROLL BENDING: The roll bending machine makes curved shapes, usually in heavy gauge sheet or plate. The machine consists of three opposing rolls, which are adjustable to produce the desired degree of bend.

TUBE BENDING: Stainless steel tubing is being used increasingly for architectural and industrial railings because of advantages in strength, corrosion resistance and durability. Designers commonly take advantage of tube bending capabilities to form returns and changes in inclination or direction for stairs and corner conditions. Stainless steel tubing can be bent on conventional equipment without difficulty, but fabricators should be consulted to determine individual limitations in producing architecturally acceptable bends in various gauges and sizes.



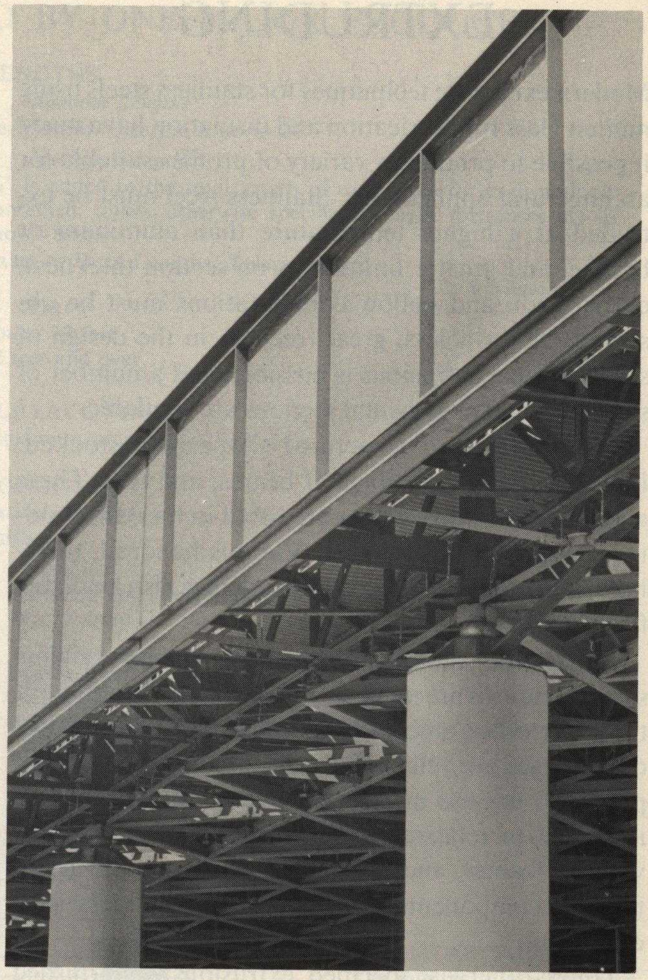
There are basic limitations in bending any metal tube. A tendency exists for the tube structure to buckle or collapse. The thicker the walls of the tube in relation to its diameter, the more "structural stability" it has, and the less likely it is to produce local distortion in bending. The smaller the radius of the bend with relation to the diameter of the tube, the more difficult it becomes to produce an acceptable bend.

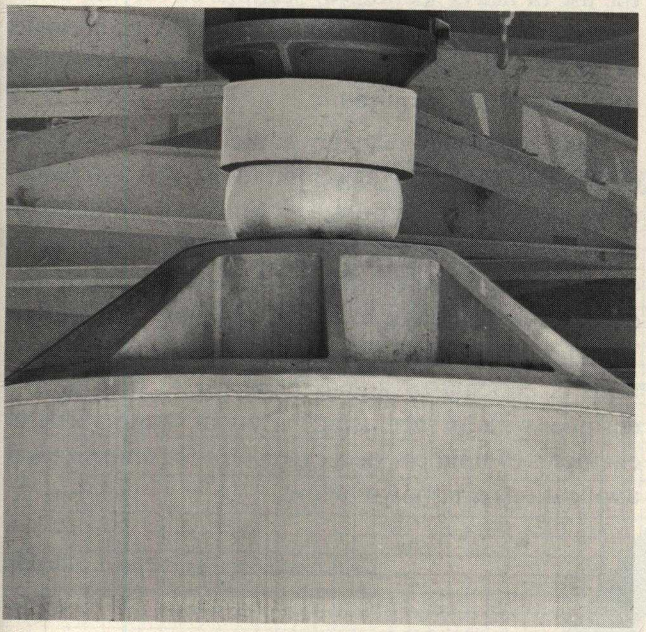
In order to prevent collapse in more severe tube bending, sand fillers and various types of mandrels can be used to support the tube internally. Recently special mandrels have been developed which will permit the forming of relatively severe bends in square and rectangular as well as some irregularly shaped tubing, thus providing the architect with greater design latitude. A three-die press, roll-bending machine (A), fixed-die machine (B) and a rotating-die machine (C) can all be used to bend tubing.

CASTING

Castings of stainless steel are used for architectural hardware items and for ornamental purposes in sculpture and plaques. High strength and resistance to wear and exposure make stainless steel ideal for hardware applications, and castings are used to form pivots, pulls, latches, handles, brackets, and fittings. As more foundries are acquiring the equipment and technical knowledge required to pour stainless steel, the use of castings is becoming more widespread.

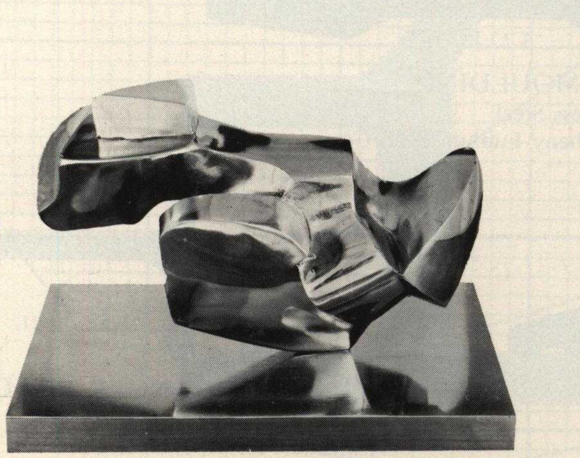
Stainless steel castings are occasionally used structurally. Pier bearing caps supporting the roof of the National Airlines terminal at the John F. Kennedy International Airport in New York were formed from castings of Type 304 stainless steel.

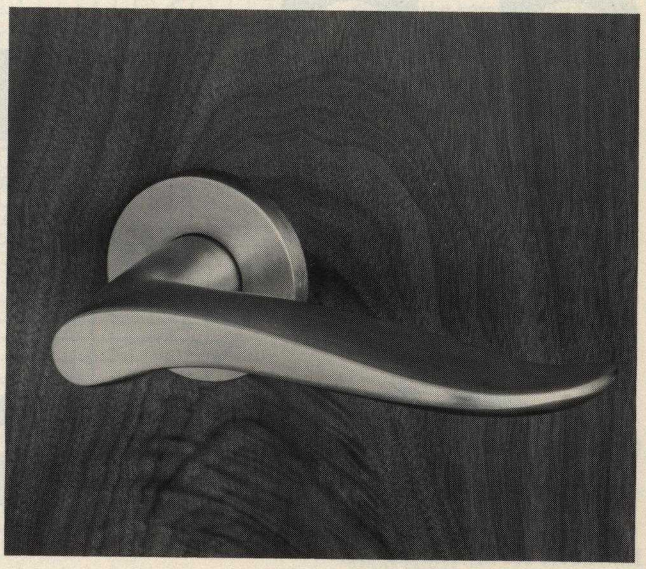




NATIONAL AIRLINE TERMINAL
John F. Kennedy International Airport,
New York, N.Y.

Architects: I. M. Pei and Partners, New York
Foundry: Cooper Alloy Corp., Hillside, N. J.





EXTRUDING

Modern extruding techniques for stainless steels using molten glass for lubrication and insulation have made it possible to produce a variety of profiles suitable for architectural applications. Stainless steel must be extruded at a higher temperature than aluminum or bronze, and greater limitations on section thickness, corner radii and hollow configurations must be observed. Nevertheless, great freedom in the design of stainless steel extrusions is possible, and a number of structural and ornamental sections are available.

Many standard structural shapes are stocked, including angles, channels, I-beams, and tees. These and other extruded shapes are listed in the Mill Products section of this manual. Various handrail, threshold, and other architectural shapes are also available from stock.

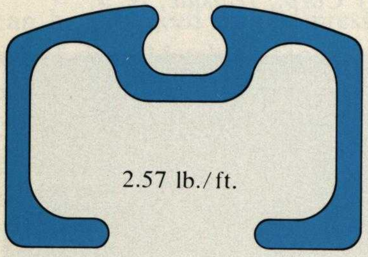
Initial-order design and set-up charges for stainless steel extrusions are modest, comparing favorably with those for other architectural metal extrusions. Since die changes are relatively simple, and short runs are practical, the use of custom shapes can be economical even in relatively small installations. Mullions, window frames, and door stiles are among the architectural components utilizing custom stainless steel extrusions.

Unless otherwise specified, extrusions are furnished in the "as extruded" condition, or are pickled to improve surface appearance. The designer may wish to consider using extrusions left in either of these conditions, but with one or more faces polished for contrast. The resulting "highlighted" appearance can be visually effective and is lower in cost than designs requiring the polishing of all exposed surfaces. For example, a T-mullion could be polished on the exposed face to contrast with "natural" returns left in the "as extruded" or pickled condition. Most mechanical finishes, including blasting and polishing, can be applied to stainless extrusions. Extruded stainless responds satisfactorily to all methods of welding and most common fabricating techniques, provided the normal recommendations for working the material are followed.

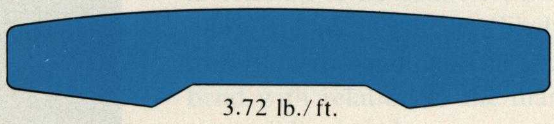
The high temperatures and large mechanical forces required in the extrusion of stainless steel alloys establish die design limitations which generally require the use of sections heavier and correspondingly higher in cost than comparable brake formed or roll formed shapes. However, extrusions can be the most economical solution for design problems in which the use of heavy sections or sections of varying thickness is advantageous, or in which profiles too complex to be practically or economically brake formed or roll formed are required.

Page 9 provides design guidelines for stainless extrusions, including size limitations and tolerances as established by one producer. Since new equipment, techniques, and stainless steel alloys are being developed continually, the designer should consult the extruder or fabricator to obtain the latest capabilities. The development of thinner and more complex sections is anticipated and is expected to provide the designer with an increasing variety of shapes. Several examples of stainless steel extrusions for architectural applications are shown below.

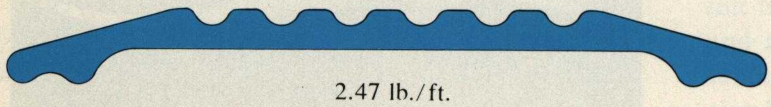
All extrusions are shown full size.



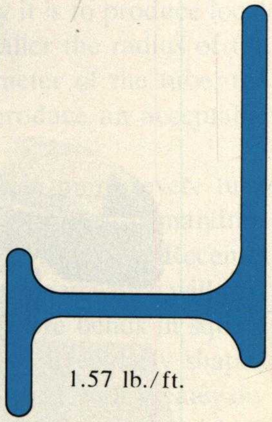
DOOR STILE
Type 304 Stainless Steel
Extruder: H. M. Harper Co.



HANDRAIL MOULDING
Type 304 Stainless Steel
Extruder: Allegheny Ludlum Steel Corp.



THRESHOLD
Type 304 Stainless Steel
Extruder: H. M. Harper Co.



MASONRY HANGER BRACKET
IN-744 Stainless Steel
Extruder: H. M. Harper Co.

EXTRUSION GUIDELINES ESTABLISHED BY ONE MAJOR PRODUCER

CROSS SECTIONAL DIMENSIONS

Specified Dimensions	*Tolerance*
Under 1″	plus or minus .020″
Over 1″ to 3″ inclusive	plus or minus .030″
Over 3″ to 5⅜″ inclusive	plus or minus .046″

TRANSVERSE FLATNESS

Allowable deviation from flat is .010″ per inch of width; .010″ minimum on dimensions less than one inch.

CAMBER

Straightness may deviate ⅛″ in any 5 feet, but not to exceed:

$$\tfrac{1}{8} \times \frac{\text{number of feet in length}}{5}$$

TWIST

Straightness may deviate

Width of Section	*Rise in 5 feet*
½″ to 1½″ inclusive	0.125″
Over 1½″ to 5″ inclusive	0.188″

The above not to exceed amount of:

$$\text{rise} \times \frac{\text{number of feet in length}}{5}$$

ANGLES

Plus or minus 2 degrees.

LENGTHS

Random Lengths:

Permissible variation is up to 24″

Multiple Lengths:

¼″ is added to the total length of each piece for each multiple contained, unless otherwise specified. Length tolerances are as shown below.

Exact or Dead Lengths: Tolerances are

Length	*Variation* *Over*	*Under*
Under 12 feet	3⁄16″	0
12 feet and over	¼″	0

SURFACE FINISH

Maximum roughness: 250 Rms.

CONDITION

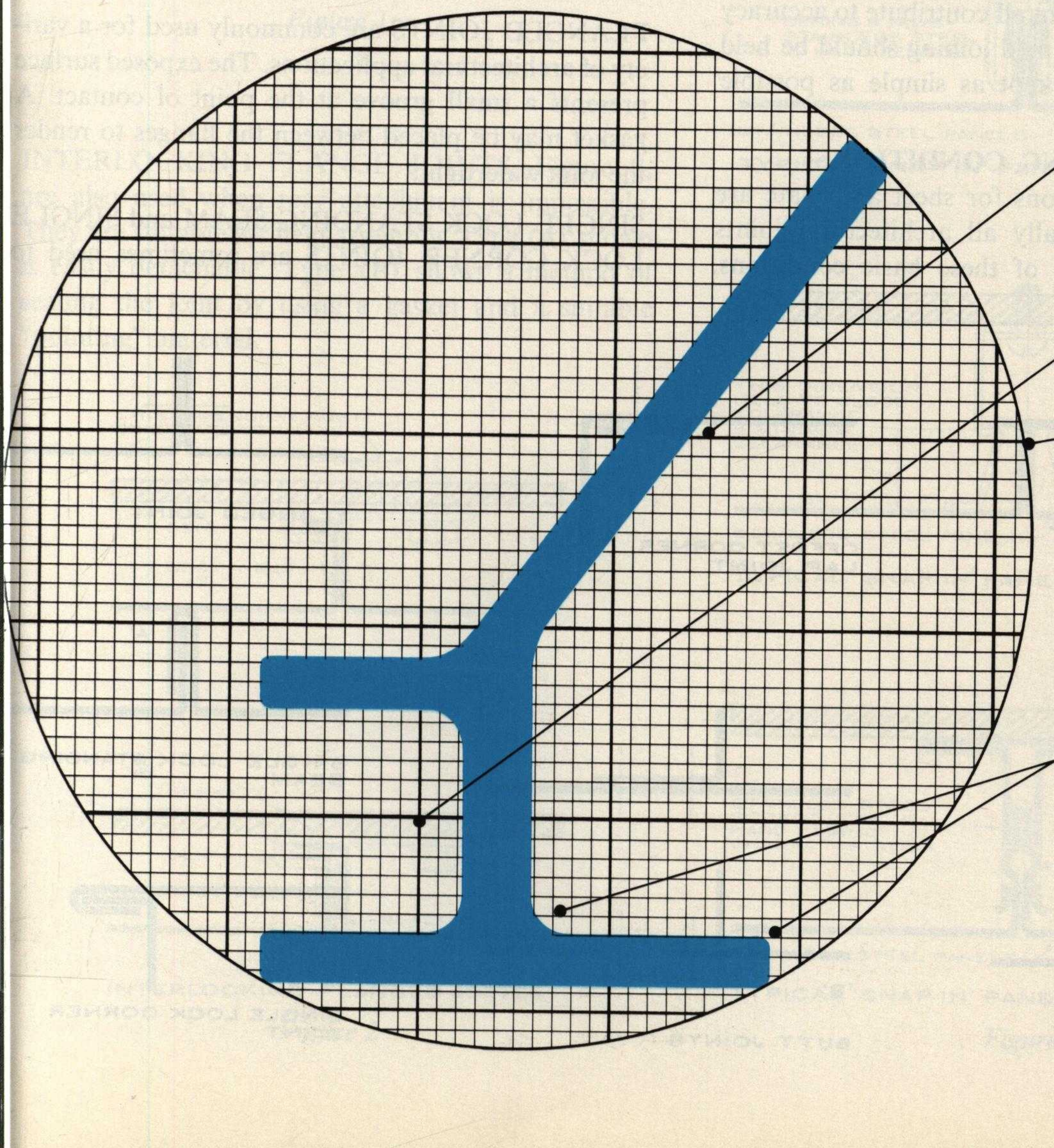
Extruded shapes are available in the following conditions and finishes:

Condition

1. Extruded and straightened
2. Heat treated

Finish

1. Hot finished
2. Deglassed
3. Pickled, blast cleaned, or otherwise descaled
4. Cold drawn



MINIMUM THICKNESS: The minimum web thickness is 0.125 inch, depending upon alloy. The maximum ratio of cross-section length to thickness is 14 to 1 for each segment of section.

INDENTS: Depth of indent should be no greater than the width of the indent.

CIRCUMSCRIBED CIRCLE: This is the diameter of the smallest circle that will completely enclose the cross-section of the shape. The maximum circumscribing diameter is 5⅜ inches.

LENGTH: Extruded shapes can be straightened in lengths up to 60 feet. Lengths up to 28 feet can be deglassed and heat treated.

CORNERS AND FILLETS: Normal production radii on corners are .062 (± .032) inch; and on fillets 0.250 (± .062) inch.

MINIMUM AND MAXIMUM: The minimum cross section area is 0.280 square inch. The maximum product weight is approximately 25 pounds per foot, depending upon alloy.

JOINING GUIDELINES & CONDITIONS

Joints and connections between building components are among the most important elements of detail design. Failures of joints and attachments can be dangerous, difficult to repair, and cause damage to adjacent materials by permitting the entry of dirt and moisture.

Unlike structural steel, there are virtually no generally accepted standard connections for architectural metal work in stainless steel. The designer aims to achieve simplicity, structural efficiency and economy. Joints and attachments that take into consideration economy in both fabrication and erection can permit the use of stainless even when budgets are limited.

Precisely fitted joints may be more easily and less expensively fabricated under shop conditions where close supervision, good working conditions, and special equipment are available. Aligning fixtures, power operated clamps, accurate working surfaces, and stationary welding equipment all contribute to accuracy in shop joining. Ideally, field joining should be held to a minimum and be kept as simple as possible where required.

BASIC JOINING CONDITIONS

Primary joining conditions for sheet and plate are described below. Virtually all architectural joints involve some variation of these basic conditions.

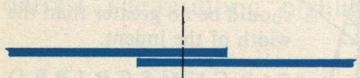
The PLAIN LAP JOINT is used with any type of attachment for all conditions. From an architecural point of view, it lacks appeal in exposed locations. The same applies to the CORNER LAP JOINT. OFFSET LAP JOINTS and CORNER OFFSET LAP JOINTS are improvements over PLAIN LAP JOINTS. They involve an extra press operation with special dies, but they lend themselves to welding or soldering to achieve pressure tightness.

BUTT JOINTS are shown: (A) —closed and (B) — separated. Attachment to a splicing or back-up member may employ spot welding, welded studs, rivets, or screws. The closed joint (A) when properly fitted and not subjected to thermal movement or distortion, shows merely a "hair line."

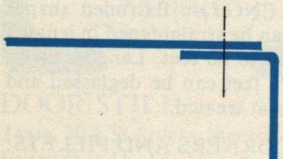
It is not employed for very light gauges (under 20-gauge) unless the stainless steel is bonded to a flat back-up material. The separated joint (B) is used for heavier thicknesses (16-gauge and thicker) to produce a "panel" effect and to visually express the joint. Slight movement of components does not affect the appearance of the joint.

FLANGED JOINTS are commonly used for a variety of architectural applications. The exposed surface presents a small groove at the point of contact. A gasket may be placed between the flanges to render the joint watertight.

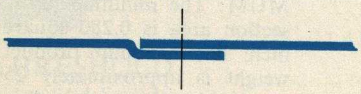
SINGLE LOCK STANDING SEAM and SINGLE LOCK CORNER JOINTS are sometimes used to



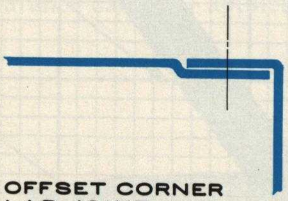
PLAIN LAP JOINT



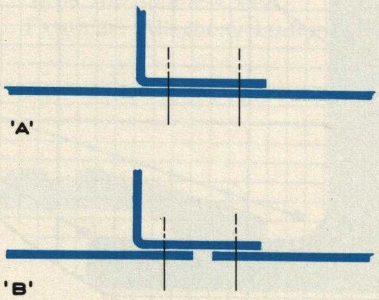
CORNER LAP JOINT



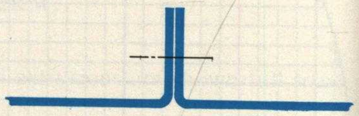
OFFSET LAP JOINT



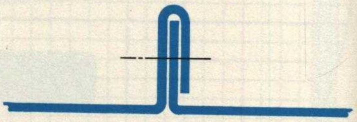
OFFSET CORNER LAP JOINT



BUTT JOINTS



FLANGED JOINT



SINGLE LOCK STANDING SEAM

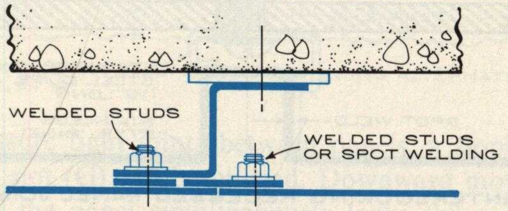
SINGLE LOCK CORNER JOINT

achieve watertightness. The joints may be soldered or filled with sealing compound.

TYPICAL ARCHITECTURAL JOINTS

Examples of joints shown below and on the following pages are typical for architectural construction. These joints may vary slightly in detail among installations, depending on the means of attachment or thickness of metal employed.

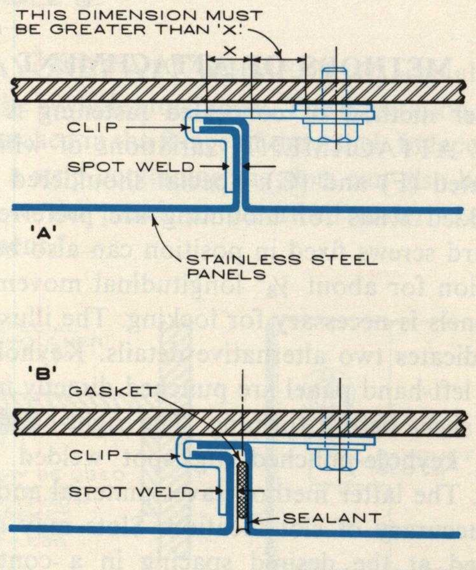
Figure 1 shows the INTERLOCKING BUTT JOINT, which is field assembled and detachable. It is used when attachment from the rear of the joint is not possible. Watertightness may be accomplished by loading the slot with a sealing compound before assembly.



INTERLOCKING BUTT JOINT

Figure 1

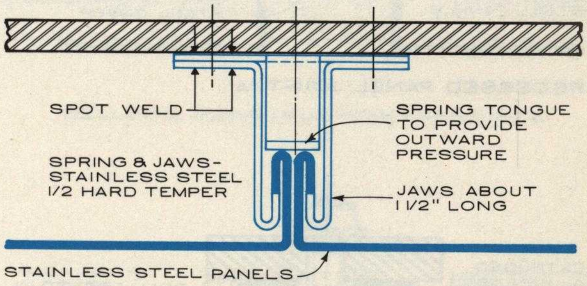
INTERLOCKING FLANGE JOINTS, Figure 2, are also used when rear attachment is impossible. They are suitable for field assembly. Type (A) shown is easily detachable. Type (B) shows a method of sealing the joint by using a gasket and a suitable "pointing" material.



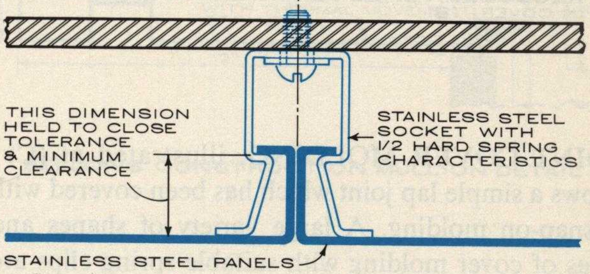
INTERLOCKING FLANGED JOINTS

Figure 2

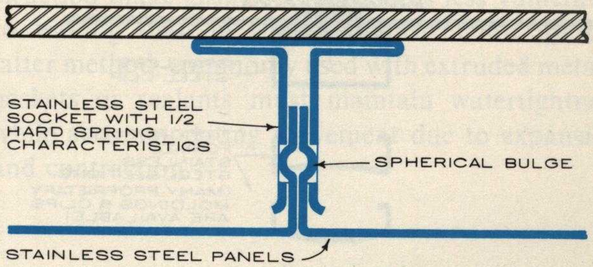
SNAP-IN JOINTS, Figure 3, may be used when the designer encounters a problem with attaching facings or panels which are not accessible from the rear and where exposed fasteners are not desirable. Typical snap-in panel joint (A) shows a detail for a flanged joint using a series of clips. The jaws hold the flanges together tightly, and a spring tongue, set in the pocket, applies outward pressure. A modification of the previous design is shown (B). Both details have a positive locking feature. Where positive locking is not desirable, an arrangement such as (C) will permit the flanged panel to be snapped out. The locking feature consists of spherical bulges on the flanges which drop into punched holes in the clip.



TYPICAL 'SNAP IN' PANEL JOINT 'A'



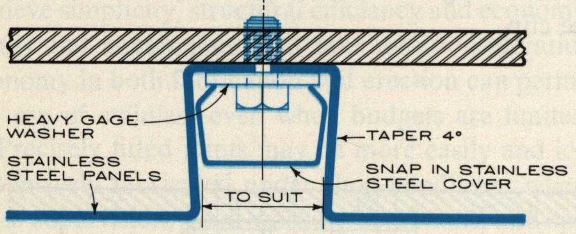
TYPICAL 'SNAP IN' PANEL JOINT 'B'



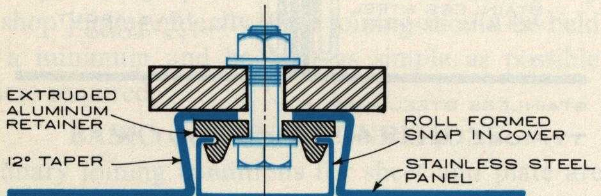
TYPICAL 'SNAP IN' PANEL JOINT (REMOVABLE) 'C'

Figure 3

The RECESSED JOINT (A) can be securely fastended from the exterior. The fastening device is then concealed by inserting a light gauge formed channel cover which is made from ¼ hard stainless steel for a greater spring effect. The panel flanges have a slight taper to prevent easy withdrawal of the cover. Flanges may be secured individually, or jointly as shown. A recessed joint with flush cover molding (B) is illustrated. The special extruded aluminum retainer provides a positive means of locking the molding, making withdrawal difficult.

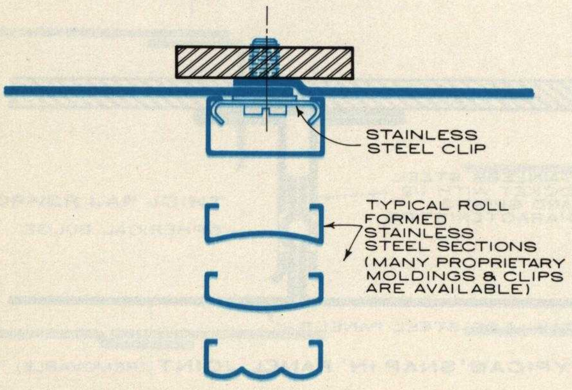


RECESSED PANEL JOINT 'A'



RECESSED PANEL JOINT (WITH FLUSH SNAP-IN COVER) 'B'

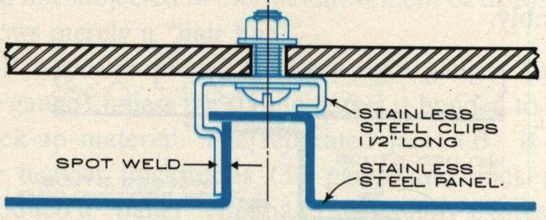
JOINT COVER MOLDING, illustrated at (C), shows a simple lap joint which has been covered with a snap-on molding. A large variety of shapes and sizes of cover molding with suitable spring clips are available from several manufacturers.



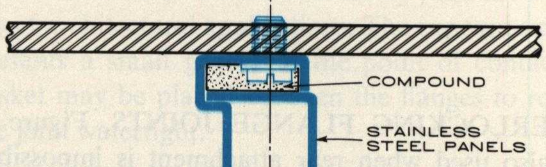
JOINT COVER MOLDINGS 'C'

The snap-in moldings above may be incorporated into joint design to produce a variety of effects, including recessed (A), flush (B), and projected or batten seam (C) reveals.

An INTERLOCKING RECESSED JOINT, requiring no cover molding, is shown (D). When watertightness is required, the construction shown (E) is recommended.



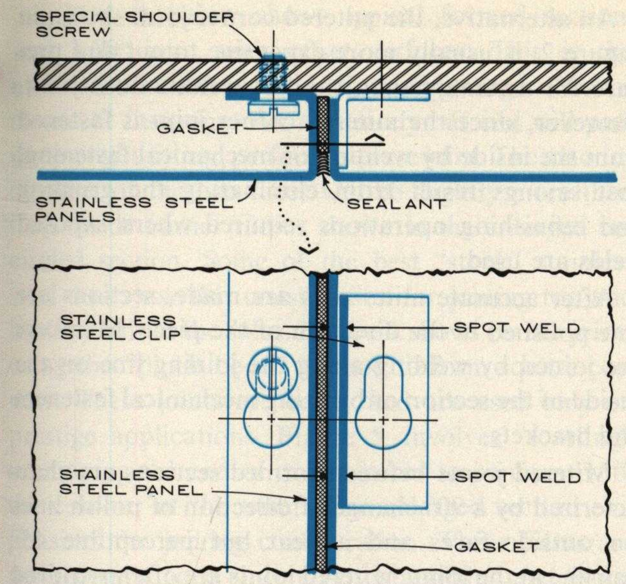
INTERLOCKING RECESSED PANEL JOINT 'D'



INTERLOCKING RECESSED PANEL JOINT 'E' (WITH SEALANT)

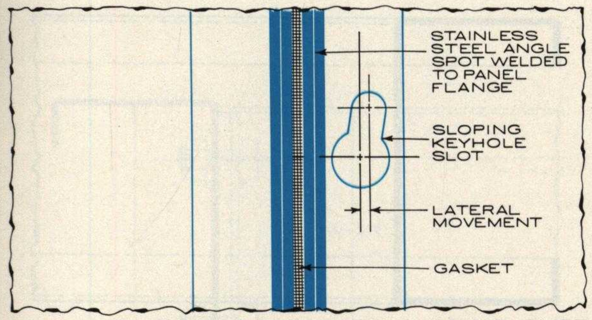
METHODS OF ATTACHMENT

Another method of concealed fastening is KEYHOLE ATTACHMENT, variations of which are illustrated (F) and (G). Special shouldered screws or welded studs for mounting are preferred, but standard screws fixed in position can also be used. Provision for about ⅜″ longitudinal movement of the panels is necessary for locking. The illustration (F) indicates two alternative details. Keyhole slots in the left-hand panel are punched directly into the panel sheet before forming. The right-hand panel has a keyhole-punched lug spot welded to the flange. The latter method saves material and facilitates accuracy of slot location. Slots may also be punched at the desired spacing in a continuous angle which is then spot welded to the flange of the panel. This method is most suitable for long panels.



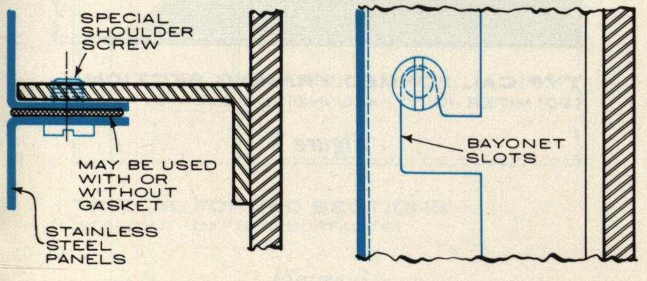
KEYHOLE ATTACHMENT (SHOWING ALTERNATE DETAILS) 'F'

To assure tight joints between panels, a sloping keyhole slot (G) can be utilized. Downward movement of the panel simultaneously locks the panel in position and draws butting panels together.



KEYHOLE ATTACHMENT WITH SLOPING SLOT IN ANGLE 'G'

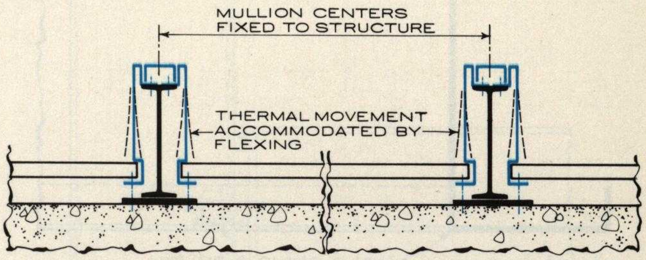
The BAYONET ATTACHMENT (H) is an alternative to the keyhole attachment. The illustration shows slots punched in the flange of the panel. Independent lugs or a strip containing the slots can also be spot welded to the panel, as described under "keyhole attachment."



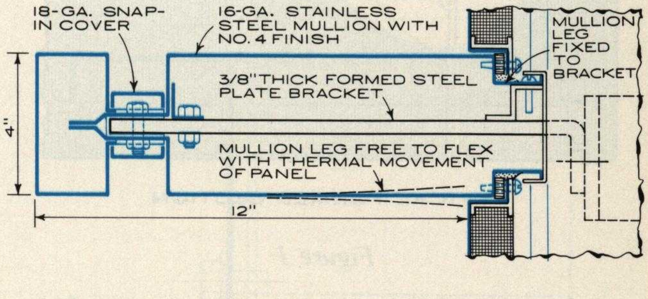
TYPICAL BAYONET ATTACHMENT FOR PANELS 'H'

BELLOWS CONSTRUCTION

Bellows construction is a technique often used in the design of architectural joints, particularly in curtain wall construction. In bellows construction mullions are fixed to the building structure, and panels are attached to the flexible mullion return. The resilience and resistance to fatigue of stainless steel permit the mullion to accommodate the thermal movement of panels by flexing.



BELLOWS CONSTRUCTION PRINCIPLE



BELLOWS CONSTRUCTION MULLION DETAIL

This method of construction has two advantages. First, it is economical. Second, the fixed joints between mullions and panels used in bellows construction make gaskets and sealants less vulnerable to leaking than in slipjoint construction. In the latter method, commonly used with extruded metals, gaskets or sealants must maintain watertightness while accommodating movement due to expansion and contraction.

JOINTS BETWEEN FORMED SECTIONS

The fabrication of ornamental windows, entrance doors and frames, and other architectural framing requires attractive and structurally sound joints between formed sections.

Figure 1 shows one of the joining methods commonly used where welded joints and flush faces are

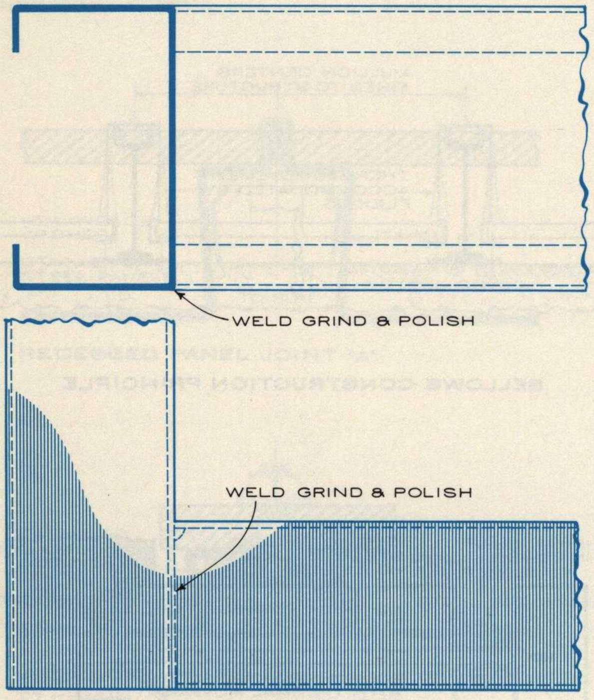


Figure 1

required. Welds are applied externally and ground flush, and the exposed faces of stiles and rails are polished. Typically, a No. 4 finish or similar line polished finish is used, but nondirectional or buffed finishes are specified occasionally. On entrance doors polish lines are usually oriented vertically on all outside faces of stiles and rails. Where proper grinding and polishing techniques are employed, welded flush joints are virtually indistinguishable from the adjacent metal. This is the preferred joining method for monumental installations.

An alternative, the mitered corner joint shown in Figure 2, is usually more expensive to cut and prepare for assembly than the 90° welded flush joint. However, since the mitered corner joint is fastened from the inside by welding or mechanical fastening, cost savings result from eliminating the grinding and refinishing operations required where exposed welds are used.

After accurate miter cuts are made, sections are line polished in the direction of the piece. Members are joined by welding along the joining line on the inside of the section or by using mechanical fasteners and brackets.

Mitered joints between formed sections are characterized by a 90° change of direction of polish lines on outside faces and a neat but perceptible 45° hairline at the joint. Mitered joints are often required for joining more complex sections, such as curved moldings or door frames with formed stops. Accurately formed mitered joints provide a continuous mating surface between connection members.

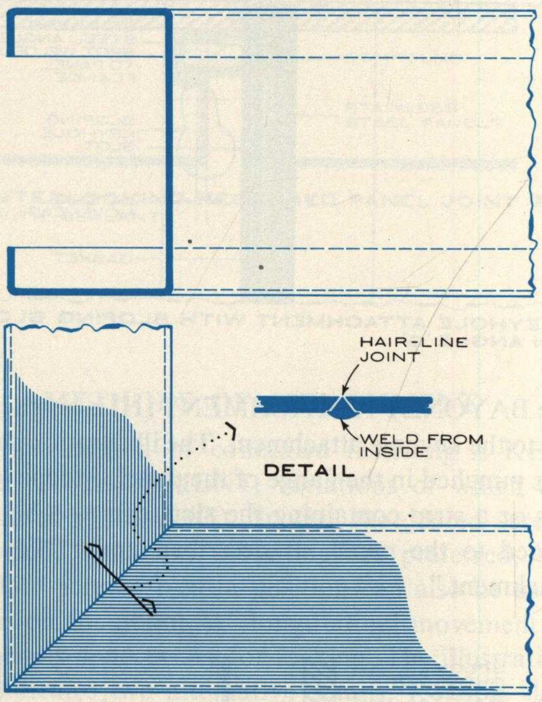
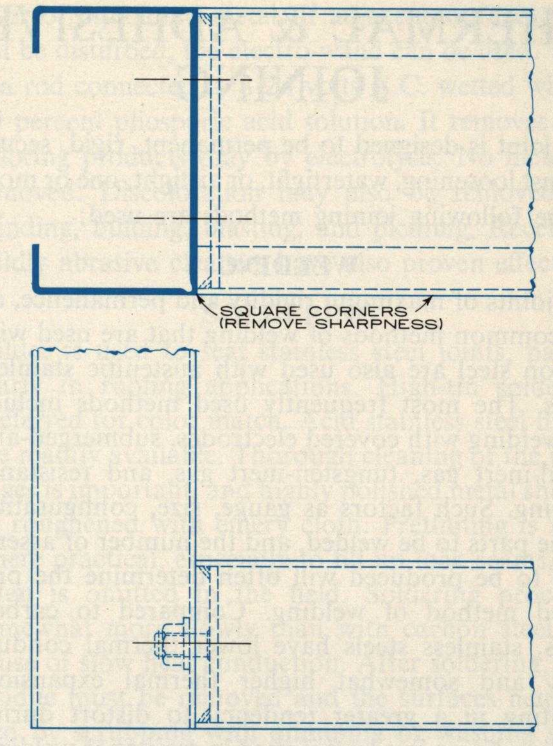


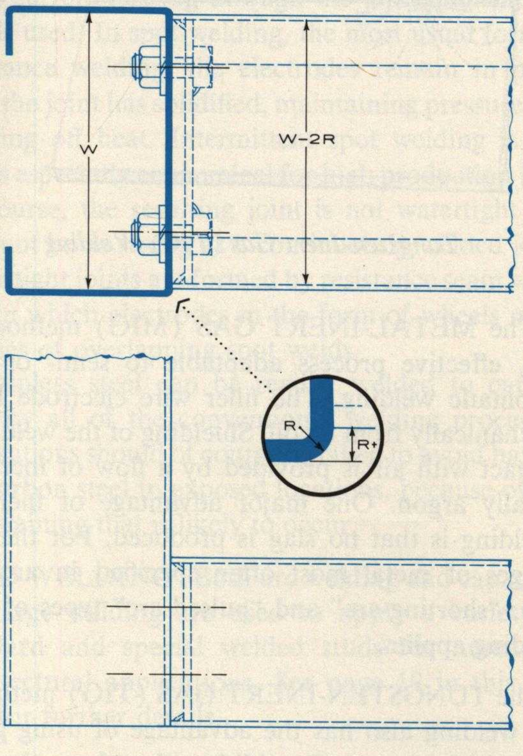
Figure 2

Figure 3 below shows typical formed sections and a 90° joint with offset surfaces. This is the most economical method of joining, regardless of means of fastening. An accurately cut end will produce a tight-fitting, perfectly square joint. The amount of offset of the two faces will be slightly more than the outside corner radius shown in the enlarged encircled section. Some of the best "stock" stainless steel doors use this construction for joining top and bottom rails to the stiles. Figure 4 shows corner joints using the "pinch bend" method to form square corners. These joints are costly and are used only on prestige applications. Figure 5 involves "scarfing" or shaping the end of one member to conform with the contour of the other. The enlarged section emphasizes the joining configuration. These joints are not recommended since costly machining and fitting operations are required to attain reasonably good appearance.



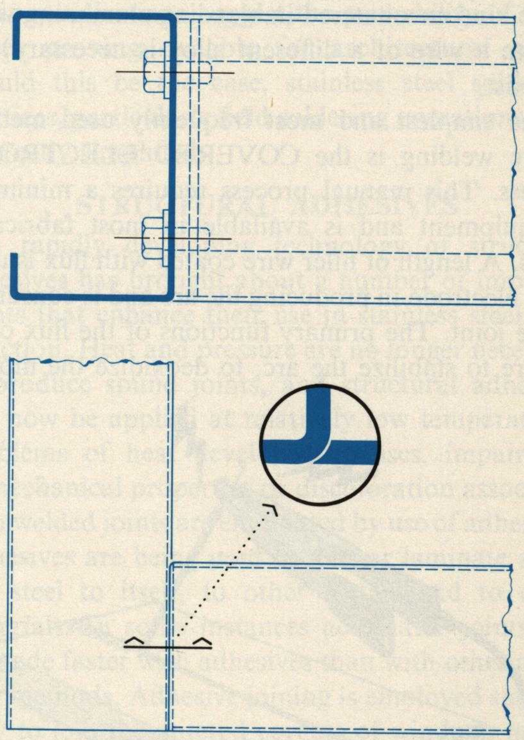
TYPICAL FORMED SECTIONS
(90° HAIR LINE FLUSH JOINT PINCH BEND)

Figure 4



TYPICAL FORMED SECTIONS
(90° JOINT-OFFSET SURFACES)

Figure 3



NOT RECOMENDED

Figure 5

THERMAL & ADHESIVE JOINING

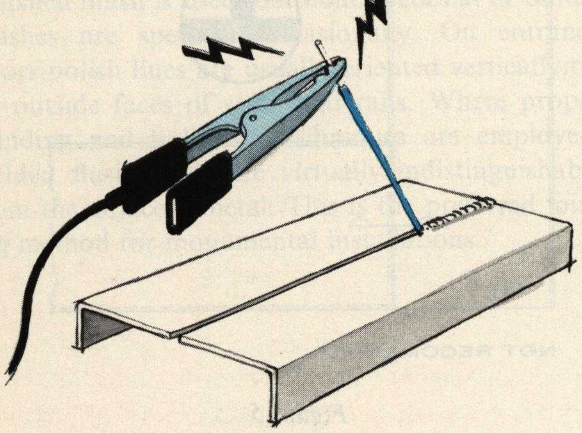
If a joint is designed to be permanent, rigid, secure against loosening, watertight, or airtight, one or more of the following joining methods are used:

WELDING

For joints of maximum rigidity and permanence, all the common methods of welding that are used with carbon steel are also used with austenitic stainless steels. The most frequently used methods include arc welding with covered electrodes, submerged-arc, metal-inert gas, tungsten-inert gas, and resistance welding. Such factors as gauge, size, configuration of the parts to be welded, and the number of assemblies to be produced will often determine the preferred method of welding. Compared to carbon steels, stainless steels have lower thermal conductivity and somewhat higher thermal expansion, resulting in a greater tendency to distort during welding. Since less heat is used in resistance welding, stainless steels are especially well suited to this method.

In arc welding, when a filler metal is required, matching stainless steel wire is used, making it practical to blend joints with the parent metal. Difficulties of the kind encountered in blending aluminum welds (where a wire of a different alloy is necessary) do not exist.

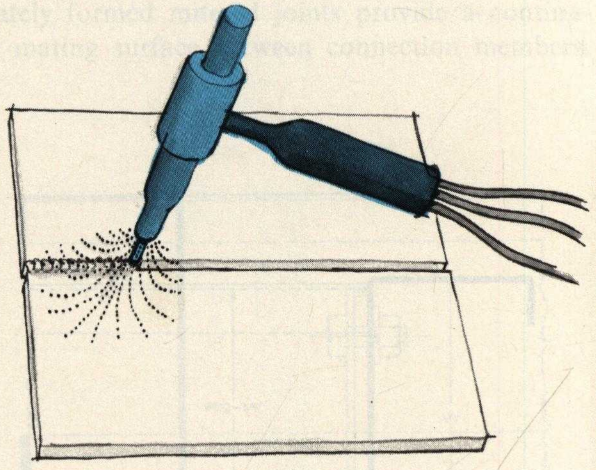
The simplest and most frequently used method of arc welding is the COVERED ELECTRODE process. This manual process requires a minimum of equipment and is available in most fabricator shops. A length of filler wire coated with flux is used as an electrode in producing the arc and is consumed in the joint. The primary functions of the flux coating are to stabilize the arc, to deoxidize the molten weld metal, and to provide protection from the atmosphere during cooling.



Covered Electrode Welding

Covered electrode welding is unsuitable for welding stainless steel sheet thinner than 20-gauge. Furthermore, when welding heavier gauges, it is not as fast as some of the automatic welding processes. On the other hand, it requires only the basic welding equipment (power source and leads) and can be used to make field joints in any position.

A faster flux-employed method is the SUBMERGED ARC process. Adaptable to automation or semi-automation, it is accomplished with various types of equipment in which the arc is produced beneath a quantity of granulated or agglomerated flux. The electrode and usually the supply of flux are fed automatically, and either the work or welding nozzle may be moved by power or manually operated equipment.

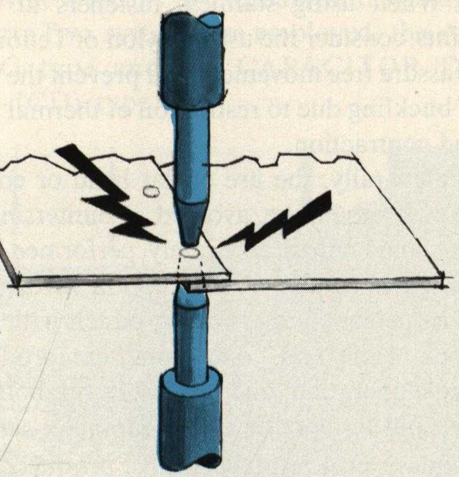


Tungsten-Inert Gas (TIG) Welding

The METAL-INERT GAS (MIG) method is a fast, effective process adaptable to semi- or fully automatic welding. The filler wire electrode is fed mechanically from a coil. Shielding of the weld from contact with air is provided by a flow of inert gas, usually argon. One major advantage of inert gas shielding is that no slag is produced. For the light gauges of metal most often specified in architecture, "shorting-arc" and "pulsed-arc" types of MIG welding applies.

The TUNGSTEN-INERT GAS (TIG) method of arc welding also has the advantage of using gas as the shielding agent. In addition, the electrode in the torch is of tungsten and is not consumed. A filler wire may be needed for a given weld. The TIG method is slower than MIG welding, particularly for

heavy material. However, control is especially good and the method is highly applicable to materials in the range of 0.005″ to 0.12″ thick. Also, spatter is eliminated and heat discoloration of the surrounding metal can be held to a light tint.



Resistance Spot Welding

In RESISTANCE WELDING, the overlapping parts being joined are held between two electrodes which apply pressure. Heat is produced by an electrical current passing through the joint. No filler or flux is used. In spot welding, the most usual form of resistance welding, the electrodes remain in place until the joint has solidified, maintaining pressure and drawing off heat. Intermittent spot welding is fast and is especially economical for high production jobs. Of course, the resulting joint is not watertight and may not be as strong as a continuously welded joint. Watertight joints are formed by resistance seam welding, in which electrodes in the form of wheels make a series of overlapping spot welds.

Stainless steel can be readily welded to carbon steel by all of the conventional welding processes. Precautions should of course be taken to avoid having the carbon steel in exposed locations, because of the rust staining that is likely to occur.

STUD WELDING: Both arc welding and capacitor discharge welding are used to apply a variety of standard and special welded studs for numerous architectural applications. See page 19 in this section for further details.

REMOVAL OF WELD DISCOLORATION is often necessary where the heat of welding discolors the surrounding area. Electro-chemical or mechanical methods are used in such cases to remove the thin layer of discolored metal. If adjacent surfaces cannot be disturbed, the electro-wand can be used. This is a rod connected to 8-24 volts A.C. wetted with a 50 percent phosporic acid solution. It removes discoloring products only by electrolysis. No metal is removed. Discoloration may also be removed by grinding, buffiing, blasting, and pickling. Recently, mildly abrasive cleaners have also proven effective.

SOLDERING

Solder is used to seal stainless steel joints, particularly in roofing applications. High-tin solder is preferred for color match. Acid stainless steel fluxes are readily available. Thorough cleaning of the joint edges is important, and highly polished metal should be roughened with emery cloth. Pretinning is used where practical, especially to fill up lock seams, but often is omitted in the field. Soldering proceeds somewhat more slowly than with carbon steel because of slow heat conduction. After soldering, flux residue must be removed and the surfaces neutralized by scrubbing with ammonia or washing soda and then thoroughly rinsed with water.

Recently, promising results have been obtained from field and laboratory tests of fluxes specially developed to eliminate the need for neutralizing operations. While tests are not conclusive at this writing, indications suggest the probability of these fluxes proving suitable for architectural work. Should this be the case, stainless steel soldering practices, particularly field soldering operations, will be greatly simplified.

STRUCTURAL ADHESIVES

The rapidly developing technology of structural adhesives has brought about a number of improvements that enhance their use in stainless steel construction. Heat and pressure are no longer necessary to produce sound joints, and structural adhesives can now be applied at relatively low temperatures. Problems of heat developed stresses, impairment of mechanical properties or discoloration associated with welded joints are eliminated by use of adhesives. Adhesives are being used to join or laminate stainless steel to itself, to other metals and to other materials. In some instances acceptable joints can be made faster with adhesives than with other available methods. Adhesive joining is employed successfully to join the mitered corners of windows manufactured by United Stainless Window Corporation (See Applications section, page 45.) Additional information on adhesives appears in Laminating and Adhesive Bonding on pages 21 and 22 of this section.

MECHANICAL JOINING METHODS

FASTENING GUIDELINES

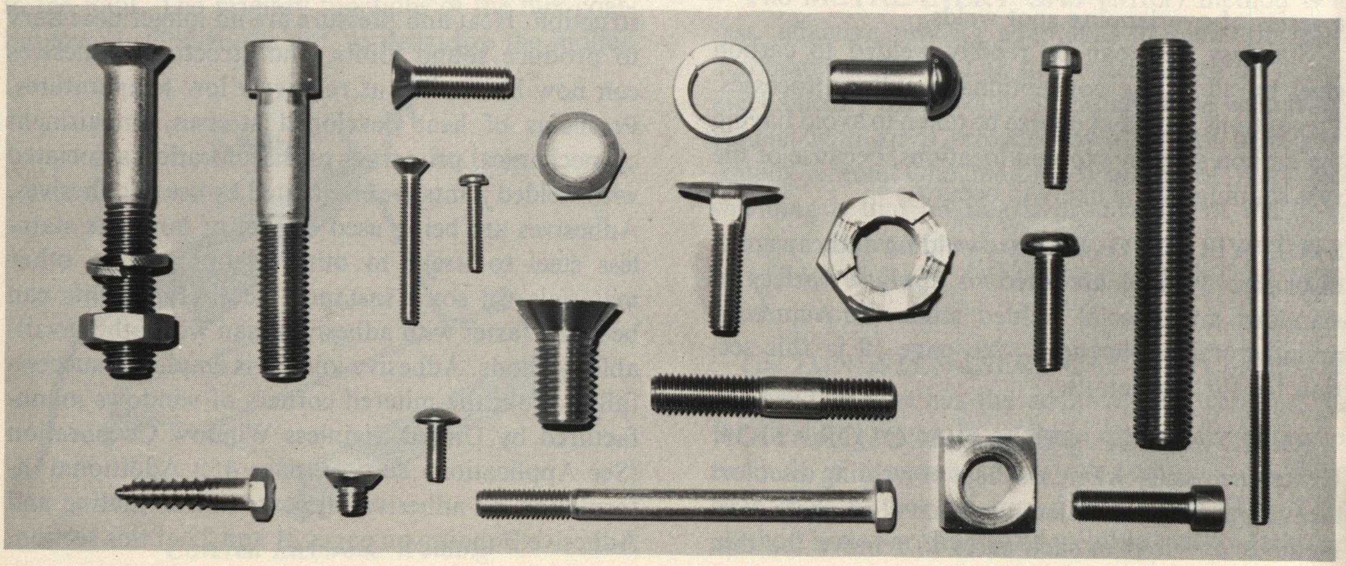
A full selection of austenitic stainless steel screws, bolts, clips, and other fastening hardware is available and is used for fastening stainless to stainless and stainless to other metals and materials. Stainless steel fasteners are also preferable for fastening aluminum parts. Carbon steel fasteners should not be used for joining stainless components, even when the fasteners are concealed. This precaution will prevent the possibility of rust streaks appearing at joints.

Special purpose fasteners have been devised to suit the individual equipment and techniques of some fabricators. For this reason the architect usually allows fabricators to use alternative fasteners, subject to approval when shop drawings are submitted. The following guidelines for fasteners will be useful for the designer and specification writer:

1. When fasteners are to be exposed to outdoor atmosphere or damp conditions, specify Type 302, 304, or 305 stainless steel.
2. For highly corrosive atmospheres, specify Type 316 stainless steel.
3. For indoor applications not subject to corrosive exposure, stainless steel fasteners of the 400 series, (such as Type 410 or 430) perform satisfactorily and are slightly lower in cost than 300 series fasteners. However, since 300 series fasteners are more widely available in a greater variety of types and offer superior resistance to possible corrosion, they are becoming increasingly preferred for interior architectural applications.
4. Lock washers, lock nuts, or some other locking device should be specified to prevent loosening of bolted connections due to vibration or thermal movement.
5. Slots or holes should be provided with liberal clearances to facilitate field assembly.
6. When using stainless fasteners at expansion joints, consider the use of nylon or Teflon* washers to assure free movement and prevent the possibility of buckling due to restriction of thermal expansion and contraction.
7. Generally, the use of flat head or countersunk screws should be avoided. Countersinking adds cost and, unless accurately performed, can yield unsightly results. An exception involves the use of a special countersinking punch with light gage stock. Hole and countersink are produced in a single operation, and the results are both economical and acceptable in appearance.

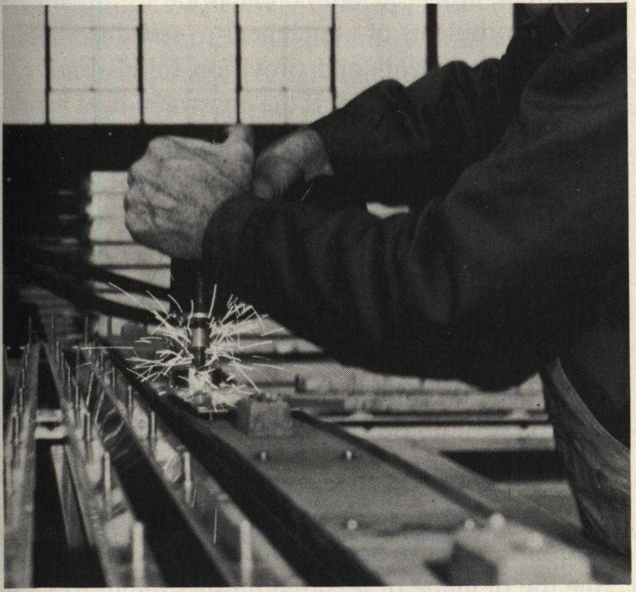
Stainless steel producers have produced standard and proprietary modifications of the basic architectural alloys, Types 302 and 304, to improve their working properties for the manufacture of fasteners. Type 305 (free spinning stainless) is one such alloy. Its low work hardening rate makes it particularly suitable for cold heading and roll threading operations. Type 303 (free machining stainless) is sometimes used for large fasteners produced by machining. Types 302, 303, 304 and 305 are often referred to as the "18-8 group" and are often interchanged by fastener manufacturers. Since strength and corrosion resistance do not vary significantly among these alloys, substitution within the 18-8 group should present no problems to the architect or fabricator.

*Registered trademark, E. I. duPont de Nemours & Co., Inc.



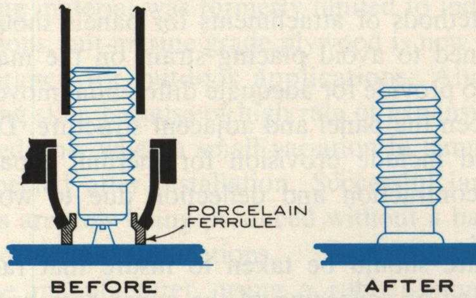
WELDED STUDS

Welded studs have gained increased acceptance as a means of fastening architectural components. Proprietary systems of special studs and stud welding guns make application fast and economical. Studs, which may be threaded or tapped, are welded to one part to provide a means of mechanical fastening to another part. Two systems are employed, the ARC WELDING type and the CAPACITOR DISCHARGE (CD) type.



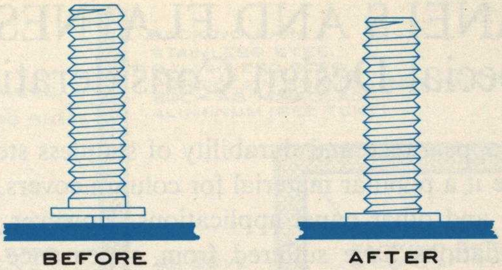
Shop application of CD welded studs

ARC STUD WELDING is used where design calls for parent metal thickness greater than 0.062″ (16-gauge), and where backside marking is not a critical factor. Arc welded stainless steel studs are available in sizes from ¼″ to 1¼″ in diameter and in any required length.



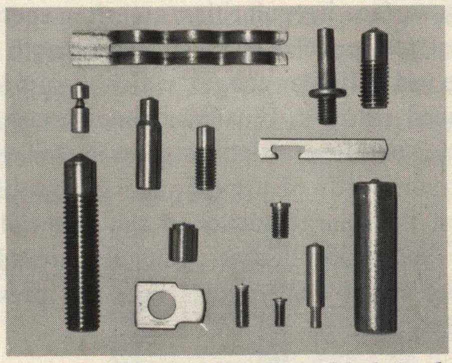
Arc Stud Welding

An excellent example of the use of arc stud welding is found in the St. Louis Gateway Arch, which utilized 260,000 stainless steel welded studs 5⁄16″ in diameter to secure its outer skin of stainless steel plate to an inner structure of carbon steel.



Capacitor Discharge Stud Welding

CAPACITOR DISCHARGE (CD) STUD WELDING is used to fasten small diameter (¼″ and smaller) studs to stainless steel or other metals. The process is particularly suitable for use with light gauge sheet, since virtually no marring occurs on the face of the sheet opposite the weld. The before and after condition of a typical CD welded stud is shown above.



Typical Stainless Steel Welded Studs

Special fastening devices such as split pins, rivets, tapped pads, and bending tabs can be attached by the stud welding process. Welded studs with heads designed for snap-in, keyhole, or bayonet attachment to facilitate blind fastening are also available. A few examples are shown in the accompanying illustration. Manufacturers should be consulted for such special attachments. Many of the design examples throughout this manual utilize this efficient means of attaching stainless steel components.

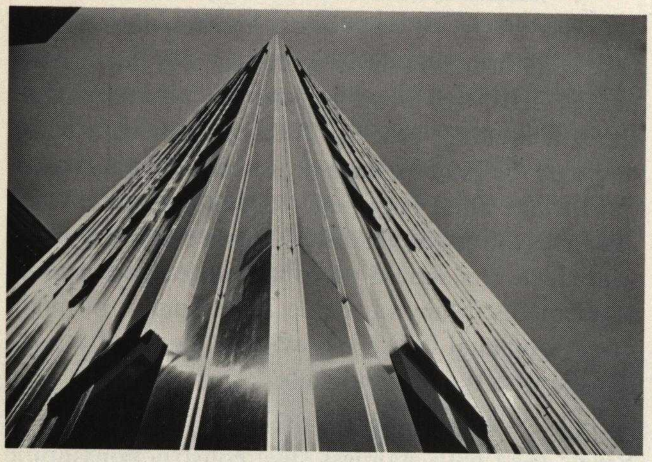
RIVETING

Rivets used with stainless steel construction should be of stainless steel or high nickel alloy. Blind rivets, which permit fastening when only one side of a component or assembly is accessible, are especially suitable for architectural applications. This method of attachment is employed by Fenestra's Fen-Clad curtain wall framing system to mount stainless steel mullion covers. Internally threaded tubular blind rivets of stainless steel are used to mount stainless steel window washing guide track to the column covers of New York's World Trade Center. (See page 16 of the Applications and Architectural Products section.)

PANELS AND FLATNESS—
Special Design Considerations

The appearance and durability of stainless steel has made it a popular material for column covers, spandrels and other panel applications. However, many installations have suffered from appearance problems caused by "waviness" or lack of visual flatness. Obtaining visual flatness is a problem with all architectural metals; all flat diaphragms, including flat metal sheets, are inherently structurally unstable; thus, any uneven application of force tends to produce a permanent deviation from plane.

Visual flatness has been a somewhat greater problem with stainless steel than other materials for several reasons. Highly reflective finishes, which tend to magnify surface irregularities, are often specified for stainless steel panels. High tensile strength encourages the use of lighter gauges, which results in panels of reduced stiffness. Finally, stainless steel is often chosen for use on prestige installations for which the highest standards of appearance are required. If, however, the characteristics of the material are respected and basic design principles are observed, achieving visually flat panels does not present any unusual difficulties.



A study by A I S I performed at Princeton University in 1955 devised a means of measuring flatness and published standards for acceptable visual flatness of stainless steel panels in a variety of finishes. However, the Princeton Study criteria have not been generally accepted among architects and fabricators for several reasons. First, the acceptability of visual flatness for a given panel installation can be influenced by building type, visual effect of adjacent materials and variations in individual standards of judging. Further, fabricators have objected that the cost and difficulty of maintaining the slope limitations recommended by the study are not justified by improved appearance.

Many architects and fabricators prefer the construction of mock-ups as a means of investigation problems and establishing standards of visual flatness. The use of mock-ups allows the fabricator to investigate forming and joining methods, permits the introduction of adjacent materials to determine their effect on appearance and establishes a tangible standard for the appearance of the finished installation. Mock-ups need not be elaborate to investigate the basic problems of attachment to structure, joints between components and provision for thermal expansion and contraction. If the construction of mock-ups is not feasible, consultation with fabricators early in the project can help the designer avoid potential problems.

The following factors should be considered in the design of stainless steel panels:

1. Adequate stiffness must be provided for large, flat surfaces. This can be achieved by using heavy gauge panel material, angle or channel stiffeners or continuous poured or laminated panel back-up material.
2. The more reflective finishes, such as No. 4 or No. 2B, require more exacting tolerances in fabrication to achieve acceptable visual flatness, while the use of matte or textured finishes minimizes visual flatness problems.
3. Uneven application of heat during welding or improper practice in forming bends can set up localized stresses which cause visible deviation from flatness. The specification of annealed, stretcher-leveled sheet of the appropriate gauge and the selection of qualified fabricators help minimize flatness problems occurring during fabrication.
4. Methods of attachments for panels should be designed to avoid placing strain on the material and to provide for adequate differential movement between the panel and adjacent structure. Design should include provision for thermal expansion and contraction and deflection due to working loads.
5. Care should be taken to insure that racking warping or squeezing of the panel does not take place during erection.

Properly designed and fabricated panels can display the inherent beauty and elegance of stainless steel to maximum advantage. Awareness of potential problem areas in panel design enables the architect to exploit the aesthetic possibilities of stainless steel with confidence.

LAMINATING

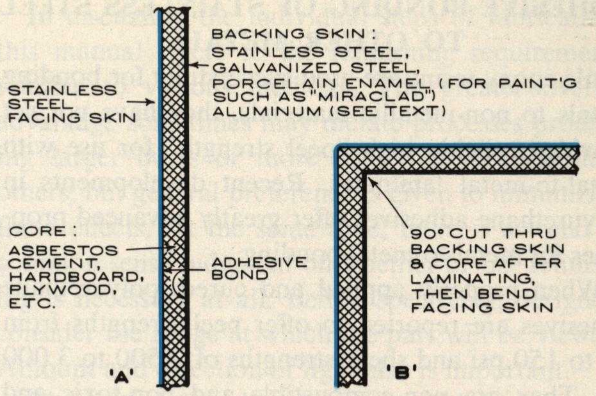
ADHESIVE BONDING OF STAINLESS STEEL TO NONMETALLIC MATERIALS

Stainless steel can be bonded successfully to several flat, board-like materials. Cement asbestos board, most of the wood product hardboards, and plywood have proven satisfactory for lamination. Each specific application requires the careful consideration of many factors. Adhesively bonded panels offer design advantages from the standpoint of both appearance and function. Adhesive lamination may help the designer solve the problems of condensation, heat transmission, insulation, moisture absorption, impact resistance, and weight.

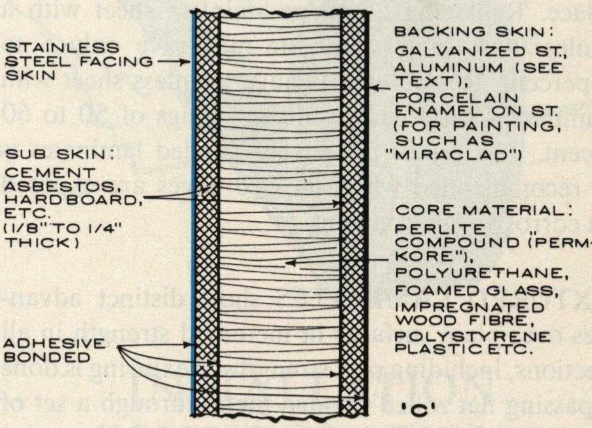
The lamination process requires considerable skill to achieve satisfactory results. Since adhesive lamination is relatively new, its technology is advancing rapidly as manufacturers attempt to achieve higher performance and greater economy. Designers and specification writers should consult experts in this field and insist that work be entrusted to experienced laminators.

Two types of laminated products are generally used architecturally, VENEER PANELS and SANDWICH PANELS. A typical veneer panel (A) consists of light-gauge stainless steel (.010″ to .031″) adhesively bonded to ⅛″ to ¼″ cement asbestos board or hardboard core. A backing or "balancing" metal skin is often necessary to prevent warping due to the differential in thermal coefficients of expansion between core and skin. The metal backing also imparts rigidity and strength to the assembly. The selection of core and backing skin materials depends upon the end use of the product. The use of plywood as a backing material was formerly limited to indoor applications, but marine grade plywood is now gaining acceptance for outdoor applications. Aluminum backing skin, because of high rate of expansion, can be used only when a small variation in temperature is expected after installation. Successful laminated panels are now being produced without a balancing skin for certain applications.

One manufacturer, using a rubber-impregnated cork and fiberboard core, has developed a panel which can be bent around columns or other curved surfaces to a radius as small as six inches. A method used to produce a sharp bend in the exterior skin is shown (B). By "V" cutting the backing skin and core with a special milling machine, the light-gauge skin can then be bent by hand, using a holding clamp.



Core materials, particularly cement asbestos board, usually require mechanical sanding before bonding to remove any surface imperfections which might "telegraph" thorough facings. The proper selection of adhesives and the technique employed in their use is of great importance in the production of a visually satisfactory and durable panel. The architect, therefore, should not attempt to set up a detailed specification for these techniques but should prepare a "requirement" specification which will confine the work to qualified laminators.



A typical Insulated Sandwich Panel (C) has a light-gauge (.010″ to .031″) facing skin, sub-skins of hardboard or cement asbestos board, and core materials adhesively bonded to form a "balanced" construction. To assure permanent flatness, panel construction should be the same from the center line of the overall thickness to each surface. There is some latitude between the thickness of facing skin and the thickness of backing skin. However, the materials should have close to the same coefficient of expansion.

Overall thickness of sandwich panels varies from ⅝″ to 3″, and the "U" value of heat transmission varies from .430 to .008 (Btu/sq. ft./hr./°F), depending upon type and thickness of core material. An excellent fire resistance rating can be attained when cement asbestos backing and formed glass or perlite compounds are used for cores.

ADHESIVE BONDING OF STAINLESS STEEL TO OTHER METALS

While epoxy resins are used successfully for bonding metals to non-metallic materials, they have not yet provided reliably high "peel strength" for use with metal-to-metal laminates. Recent developments in polyurethane adhesives offer greatly advanced properties for metal-to-metal bonding.

When properly applied and cured, polyurethane adhesives are reported to offer peel strengths from 50 to 150 psi and shear strengths of 2,500 to 3,000 psi. They are non-combustible and non-toxic and have good resistance to thermal shock.

Tests have shown no delamination under continuous exposure to temperatures up to 350°F, which permits certain types of welding when proper techniques are employed.

Standard sheet products are available using a light-gauge stainless steel cladding, plain or textured, bonded with polyurethane adhesive to a base metal of galvanized steel or aluminum. From an economic standpoint, stainless steel laminates offer savings proportional to the thickness of the solid metals they replace. Replacing 22-gauge stainless sheet with a stainless/base metal laminate may save only 5 to 10 percent. Replacing 10-gauge stainless sheet with a laminated sheet can result in savings of 50 to 60 percent. The use of adhesively bonded laminates is not recommended when sheared edges are exposed to a corrosive environment.

TEXTURED LAMINATES show distinct advantages over plain surfaces in increased strength in all directions, including peel strengths. Texturing is done by passing flat rolled bonded metal through a set of matched and synchronized male and female patterned rolls under accurately controlled pressure

SHEARING, perforating, or other cutting operations may be performed as normally done with solid metal.

FORMING can be done as with solid metal—a 180° bend over a radius twice the total thickness is practical. Roll forming, brake forming, and stretch forming can be done within reasonable limits.

WELDING. High frequency current and low heat input techniques must be employed to weld without delamination or breakdown of the adhesive.

STUD WELDING can be accomplished on the base metal with little or no marking of the surface metal.

POLISHING of the surface metal can be done as long as heat generated does not exceed 350°F.

FINISHING

There is a considerable range of rolled or polished A I S I Industry Standard Mill Finishes, all of which are presented in the "Mill Products" section of this manual. Sheet and strip products in these finishes, particularly No. 2D, No. 2B, No. 3, and No. 4, are warehoused throughout the country. In addition, certain mills offer a selection of proprietary mill finishes of their own design. These finishes are polished or roll produced for various scratched, patterned, or matte effects, and in many instances offer advantages in initial cost and blendability.

Also available is a group of proprietary special finishes provided by metal finishing specialists. These include patterns and color effects produced by texturing, etching, coating, and electropolishing.

TEXTURING is the term applied to a shallow embossed or over all indented pattern pressed into sheet or strip products. On some products the textured pattern is also color coated. In rigidizing or texturing, the metal is rolled into a three-dimensional pattern which strengthens the stock and provides interesting designs.

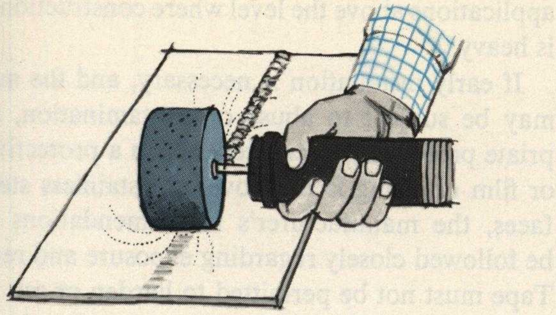
Textured and etched products also are used to meet the visual flatness requirements of broad panels and to reduce the visibility of minor scratches and dents.

ETCHING includes both acid and mechanical methods. Acid is used for an overall matte finish or to remove metal around a pattern protected by a coating during the process.

BLASTING is a mechanical method of producing frosted, etched or matte finishes by bombarding the stainless steel surface with abrasive grit, glass beads or other materials. Portable recirculating equipment is available for repairing or refinishing on site. Blasted rolls are used to produce an economical rolled matte finish which can be simulated in the field using portable blast equipment.

COATINGS, both organic and inorganic, are used with stainless steel to a limited extent. Organic coatings are generally not suited for exterior or heavy traffic installations. They are sometimes used to prefinish sheet or strip stock prior to forming if coating the formed shape is impractical or uneconomical.

Inorganic coatings include porcelain enamel and a chemically produced, opaque black oxide coating. A transparent paint or porcelain is used to permit the metal to show through the tint. Textured sheet material is often porcelain enameled to add color and enhance visual contrast. Since stainless steel itself



is durable and resitant to corrosion, economic considerations normally limit the use of coating processes to producing visual accents.

ELECTROPOLISHING is a simple electrolytic bath which produces an extremely bright luster. The finish is imparted uniformly over the piece, including the inner surfaces of recesses and fillets.

BLENDING AND REFINISHING: Stainless steel fabricators provide *refinishing* for a uniformly attractive appearance after fabrication steps that disturb the original finish. Grinding, polishing and buffing—progressively finer abrasive steps—are used to efface burrs, weld beads and scratches and to bring the surface to the desired appearance. The term *blending* applies when the fabricator works on limited areas to eliminate any visible difference between them and the original overall finish. Since welding filler is selected to match the stainless steel being joined, the fabricator can make welded joints visually indistinguishable.

Fabricators offer their own finish to avoid blending to a standard finish. The number designations of several fabricator finishes follow those of the A I S I standard mill finishes, but the finishes themselves do not necessarily match. Thus, it is well for the designer to request samples from the fabricator before specifying.

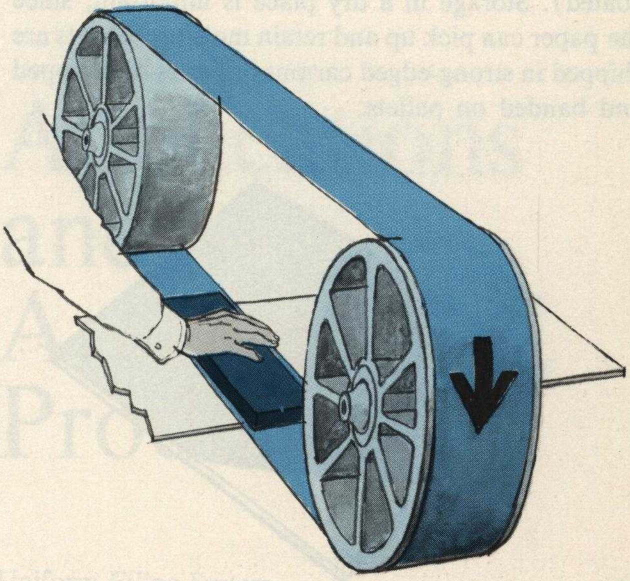
To minimize and simplify refinishing, several factors should be considered: selection of original stock, fabricating alternatives, end use and shop protective measures.

Only polished or scratch rolled products can be abrasively blended. This eliminates No. 2D, and No. 2B, which are smooth rolled. A number of *mill proprietary finishes* are specifically designed for easy bending. In some instances, the supplier provides special cloths or wheels that quickly reproduce the original finish.

Selecting a textured or etched stock may eliminate the need for blending after certain fabrication steps that produce small nicks or scratches.

In discussing the individual steps of fabrication, this manual refers to the refinishing requirements relative to various methods. The greater overall advantage sometimes may dictate processes producing larger burrs or more heat discoloration than others, but general preference is given to minimizing these effects. At the same time, there is a trend to common sense judgment on whether or not refinishing is necessary at all. Before specifying, designers consider the range at which the part will be viewed. Amount and direction of light also is important.

The *Metal Finishes Manual*, published by the National Association of Architectural Metal Manufacturers, offers detailed data useful to specification writers.



INSTALLATION CONSIDERATIONS

SHOP PROTECTION: In work, storage and shipping, every practical precaution is taken to prevent damage to finish and edges.

Shop cleanliness is especially important with stainless steel. There should be a minimum of dust, particularly metallic dust, in the work and storage areas. Carbon steel grinding should be avoided in stainless steel shop areas.

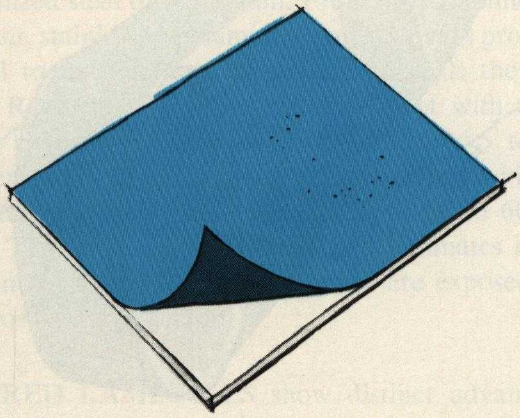
Tools not used exclusively for stainless steel should be scrubbed before they are applied to stainless to prevent particles from lodging or imbedding in the surface of the stainless steel. Such imbedded particles, unless removed by subsequent chemical or mechanical treatment, may cause corrosion. For the same reason, carbon grits and grinding wheels are avoided

and stainless steel wools are used. Sharp cutting tools and smooth forming dies are used to prevent nicks and scratches.

Prefinished sheets are usually covered at the mill, service center or shop with paper, tape or either sprayed-on or sheet plastic film (some transparent) for protection throughout fabrication and erection. Such coverings have specific limitations and service lives and following the manufacturers' recommendations eliminates removal problems.

Paper pads or temporary strips of tape are used between the work and sharp table edges, hold-downs, etc.

Interleaving paper normally is used in storage and in shipping sheet stainless steel (unless it is taped or coated). Storage in a dry place is important, since the paper can pick up and retain moisture. Sheets are shipped in strong-edged cartons or crates or wrapped and banded on pallets.



Stainless steel is protected by a natural clear oxide coating that forms on its surface. If carbon steel contamination occurs during fabrication or any other invasion of the natural protective coat causes staining, the entire piece should be immersed or swabbed with an acid cleaning solution.

INSTALLATION: Since appearance normally is important in stainless steel applications, the designer often specifies installation, handling, and scheduling details that otherwise might be left to the discretion of the general contractor.

Installation of ground floor exterior and all interior stainless steel is scheduled, if practical, after other trades have completed any work that could produce accidental scratches, dents or stains. Until that time stainless steel components should remain indoors, wrapped and in their shipping containers.

Early installation can be scheduled for exterior applications above the level where construction traffic is heavy.

If early installation is necessary, and the material may be subject to abuse or contamination, appropriate protection is required. When a protective tape or film covering is used over the stainless steel surfaces, the manufacturer's recommendations are to be followed closely regarding exposure and removal. Tape must not be permitted to harden or set.

If muriatic acid or other corrosive cleaning preparations are to be used on adjacent masonry, installation of stainless steel is scheduled after this step. If it is impractical, the stainless steel components must be flushed with water immediately after being exposed to the masonry cleaning process.

CLEANING: Thorough inspection and cleaning of the stainless steel is scheduled as one of the final construction steps. This is not only to insure the initial appearance of the job, but it will eliminate any corrosive residues and reveal any needed repairs.

Common mild detergents and warm water are usually sufficient for this step. The detergent should be thoroughly rinsed off. A final dry wipe eliminates water deposits.

After any protective paper, tape or film has been removed, a residue may be left. This may not be immediately visible, but if it remains it will act as a dirt trap. A solvent or special cleaner recommended by the manufacturer usually is needed to remove any adhesive residue.

If dust and grit is present on stainless, it should be flushed away as the first step in final cleaning. Special environmental deposits may call for special cleaning materials, as may greasy smudges, spills, construction materials and fingerprints.

Carbon steel wool must never be used. Stainless steel wool is available and is ideal. All coarse abrasive cleaners should be avoided. Use of a light abrasive powder may prove necessary, but any such product should be used with care and applied in the same direction as the grain or finish lines. Corrosive cleansers should be avoided if possible, especially those containing chlorides. If such a cleanser is required to remove a particular type of dirt, it must be followed by a thorough rinsing and drying.

Applications and Architectural Products

This section includes representative examples of a wide variety of architectural applications of stainless steel. The examples chosen are characterized by sound engineering design, interesting detailing and economical use of material. Space limitations have, in many instances, forced the choice of examples to be somewhat arbitrary, and the omission of a given class of applications or line of proprietary products is not intended to infer inferiority or lack of availability.

For ease of reference, material has been organized and presented in accordance with the Uniform Filing System established jointly by The Construction Specifications Institute and the American Institute of Architects.

UNIFORM FILING SYSTEM
Title One—Buildings

The following listing is organized in accordance with the Uniform Filing System established by The Construction Specifications Institute in conjunction with the American Institute of Architects and includes those applications for which stainless steel can be specified. In the succeeding pages selected architectural applications of stainless steel are illustrated and detailed.

DIVISION 1—GENERAL REQUIREMENTS
- (omitted)

DIVISION 2—SITE WORK

Site Improvements
- drainage grates
- fences and gates
- fountains and garden structures
- playground equipment
- signs and signals
- street furniture and trash receptacles

DIVISION 3—CONCRETE

Cast-in-Place Concrete
- anchors and inserts
- concrete reinforcement and formwork
  - breakaway form tie rods
  - expanded metal reinforcing
  - reinforcing bars
  - wire fabric and wire rebar supports
- dovetail slots and reglets
- rod and strap inserts
- threaded inserts

Precast Concrete
- anchors, straps, hangers and dowels
- decorative inserts
- permanent forms

DIVISION 4—MASONRY

Stone Anchors
- bracket and strap anchors
- clamp and dowel anchors
- dovetail anchors
- wire anchors

DIVISION 5—METALS

Anchors, Fasteners, Connectors and Supports
Balconies and Catwalks
Baseboards and Corner Guards
Hardware and Accessories
Ladders and Ladder Rungs
Lintels
Pipe and Tube Railings
Stairs and Stair Components
Tread Plates and Gratings
Ornamental Metals
- column covers and bases
- column cover guide tracks
- grilles
- facias and copings
- ornamental railings

Structural Metal

DIVISION 6—CARPENTRY

Custom Woodwork
- anchors and fasteners
- bases, feet and legs
- framework
- trim

DIVISION 7—MOISTURE PROTECTION

Expansion Joints
Flashings
Gutters and Downspouts
Roof Accessories
- scuttles
- skylights and frames

Roofing
- cleats and anchoring clips
- custom roofing panels
- fastening devices
- preformed industrial panels

DIVISION 8—DOORS, WINDOWS AND GLASS

Curtain Wall Systems and Components
Ground Floor Mullions
Panels
Finish Hardware
- cabinet hardware
- closers and checks
- doorstops and holders
- exit devices
- hinges and pivots
- kick plates
- locksets and latchsets
- push and pull units
- sash balances
- sash cleaners hooks
- sash latches and lifts
- thresholds

Doors and Frames
- balanced
- custom
- fire rated
- flush
- kalamein
- paneled
- revolving
- rolling
- sliding

Windows
- casement
- detention
- double hung
- fixed glazed
- horizontally and vertically pivoted
- sliding
- window sills

DIVISION 9—FINISHES

General Information
Acoustical Ceiling Panels
Stainless Steel Pigmented Paints
Terrazzo Dividing Strips

DIVISION 10—SPECIALTIES

Chalkboard and Tackboard Frames and Trim
- trim and accessories

Chutes
Compartments and Cubicles
- hospital
- office
- toilet and shower partitions

Demountable Partitions
Firefighting Devices
- extinguisher cabinets

Flagpole and Masts
Identifying Devices
- bulletin boards and directories
- letters and insignia
- tablets and plaques

Lockers
Postal Specialties
- letter slots
- mailboxes

mail chutes
Sun Control Devices
- awnings and sunshades
- fins and louvers
- marquees and canopies

Telephone Booths
Toilet and Bath Accessories
- bars, hooks and holders
- cabinets and dispensers
- racks and shelves
- waste receptacles

DIVISION 11—EQUIPMENT

Bank Equipment
- depositories
- drive-in windows
- lock boxes
- safes
- teller cages and counters

Commercial Equipment
- bar and restaurant equipment
- display cases
- shelves
- store fixtures
- turnstiles

Darkroom Equipment
- developing tanks
- table tops

Ecclesiastical Equipment
- baptistries
- bells and carillons
- spires and steeples
- crosses, emblems and devices

Food Service Equipment
- beverage dispensers
- dishwashers
- garbage grinders
- ice makers
- kitchen machines
- ovens
- pot racks
- refrigerated cases
- service carts
- serving line units
- sinks
- worktables

Industrial Equipment
- food and beverage processing equipment

Laboratory Equipment
- fume hoods
- laboratory casework
- sinks and countertops

Laundry Equipment
Medical Equipment
- hospital casework
- sterilizers
- operatory equipment
- therapy equipment

Mortuary Equipment
Parking Equipment
- attendant shelters
- drive-up ticket dispensers

Prison Equipment
Residential Equipment
- disposal equipment
- exhaust hoods
- laundry equipment
- lavatory cabinets
- ranges and ovens
- refrigerated units
- sinks
- unit kitchens

DIVISION 12—FURNISHINGS

Artwork
- plaques and bas-reliefs
- sculpture

Carpet Static Grounding Fibers
Furniture
Seating
- auditorium and stadium chair backs and trim

DIVISION 13—SPECIAL CONSTRUCTION

Cold Storage Rooms
- doors, frames and hardware
- shelves
- wall lining

Incinerators
Storage Vaults
- doors and equipment

Swimming Pools
- ladders and towers
- prefabricated pools

Zoo Structures

DIVISION 14—CONVEYING EQUIPMENT

Baggage Conveyors
Elevators
- cabs and entrances
- control panels

Hoists and Cranes
- window washing scaffold guide tracks

Materials Handling Systems
Moving Stairs and Walks
- facings and trim
- rails

Pneumatic Tubes

DIVISION 15—MECHANICAL

Air Filtration Equipment
Air Handling Equipment
- diffusers
- ductwork
- fans and blowers
- louvers, registers and grilles

Drainage Fittings
- floor and roof drains

Fire Extinguishing Equipment
- hose reels and cabinets
- hydrants

HVAC Equipment
- convectors and radiator enclosures

Pipe and Pipe Fittings
Plumbing Fixtures and Trim
- bath and toilet fixtures
- drinking fountains
- fixture trim
- sinks and wash fountains

Refrigeration
- cooling towers
- louvers
- fans
- structural members

Valves
Waste Treatment Equipment
Water Supply Systems

DIVISION 16—ELECTRICAL

Communications Systems
Electrical Comfort Systems
- baseboard heaters
- duct heaters
- panel heating

Lighting Fixtures
- display
- exit and safety
- surgical
- theatrical
- floodlighting
- street lights and standards

Lightning Protection Systems
Raceways and Fittings
- rigid and flexible conduit

Panelboards
Wiring Devices
- convenience outlets
- face plates

APPLICATIONS AND ARCHITECTURAL PRODUCTS

The format used in this section for the presentation of architectural applications of stainless steel follows the Uniform System for Construction Specifications, Data Filing and Cost Accounting, Title One—Buildings. Division 1, General Requirements, has been omitted because its provisions do not apply to stainless steel installations.

SITE WORK

Figure A

Figure B

Figure C

Figure A—"Infinity", a rotating stainless steel sculpture by Jose de Rivera and Roy Gussow. The sculpture was commissioned by the Federal Government and is installed at the Smithsonian Institution's Museum of History and Technology, Washington, D. C. It measures 16 by 13 by 8 feet but weighs less than 1,000 pounds.

Figure B—Parking attendants' shelter at Marina City in Chicago is 7′-5″ in diameter by 8′-3″ high. The outside shell is .078″ stainless steel in a No. 4 finish, while the roof is decked with .050″ stainless steel with a No. 2B finish.

Architects: Bertrand Goldberg Associates, Chicago
Fabricator: Crane Fulview Glass Door Company, Deerfield, Illinois

Figure C—A stainless steel tree fountain for Canada's Garden of the Provinces in Ottawa. Water pumped through the tubular trunk and branches flows from the large leaves, which were stamped in a press.

Architects: Norman Slater, Montreal
Fabricator: Canadair Ltd., Montreal

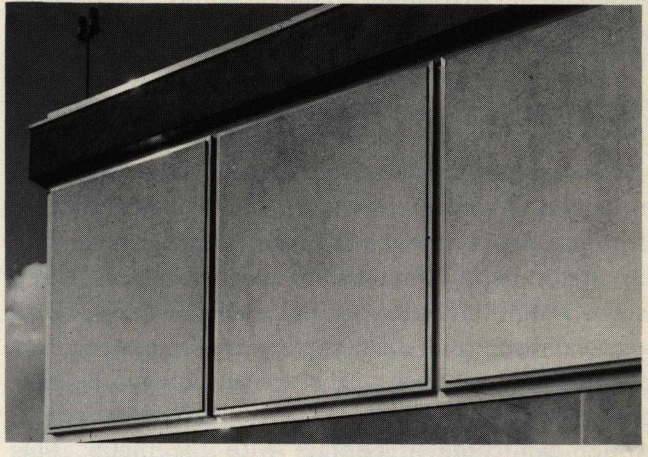
CONCRETE

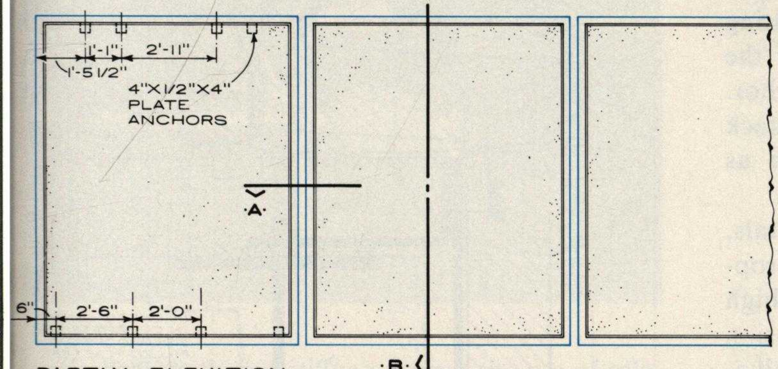
AMERICAN AIRLINES TERMINAL BUILDING WASHINGTON NATIONAL AIRPORT

Architect: Giuliani Associates, Washington, D.C.
Precast Concrete Panels: Tecfab, Inc., Beltsville, Md.
Stainless Frames: Habgood Co., Philadelphia, Pa.

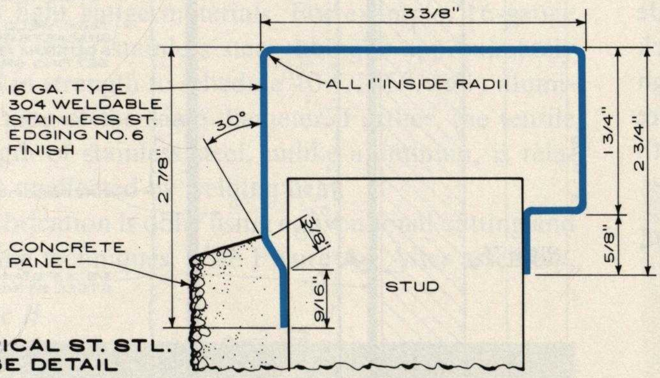
Resistance to atmospheric corrosion, compatibility with concrete alkalinity and absence of a staining oxide wash make stainless steel ideal for use with precast panel construction. In the installation on this page, rectangular frames of brake formed, 16-gauge Type 304 stainless steel surround large, precast concrete panels. The polished stainless frames, which complement the exposed panel aggregate, also served as part of the concrete form, greatly simplifying the pouring of the panels.

An extensive range of conventional concrete inserts and anchors is available in stainless steel for use in installations where staining and corrosion by-products are to be avoided.

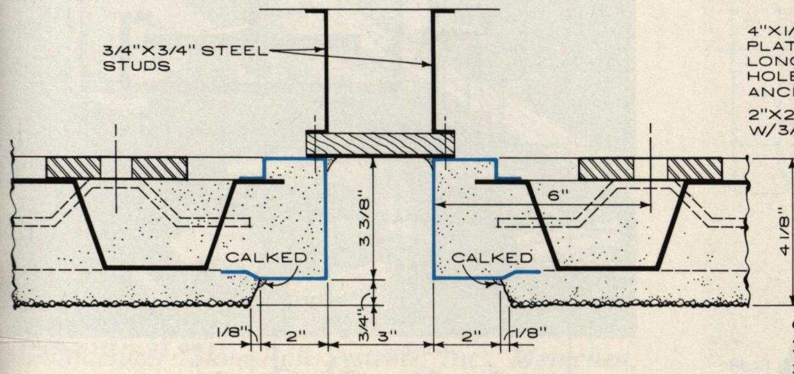




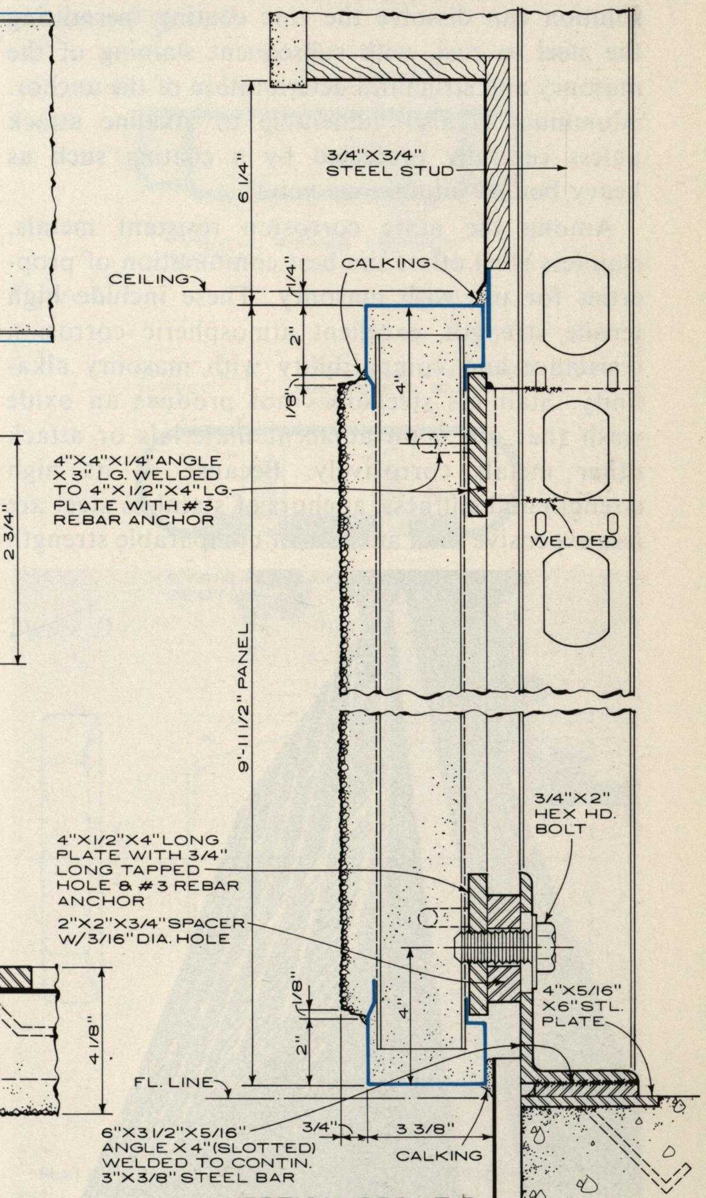
PARTIAL ELEVATION



TYPICAL ST. STL. EDGE DETAIL



PLAN SECTION AT·A· (PANEL TO PANEL DETAIL)



VERTICAL SEC. AT·B·

MASONRY ANCHORS

FIRST NATIONAL BANK, CHICAGO, ILL.

Architects: C. F. Murphy Associates and the Perkins & Will Partnership, Chicago
Masonry Fabricator: Cold Spring Granite Company, Cold Spring, Minn.
Anchor Fabricator: Zalk-Josephs Co., Duluth, Minn.

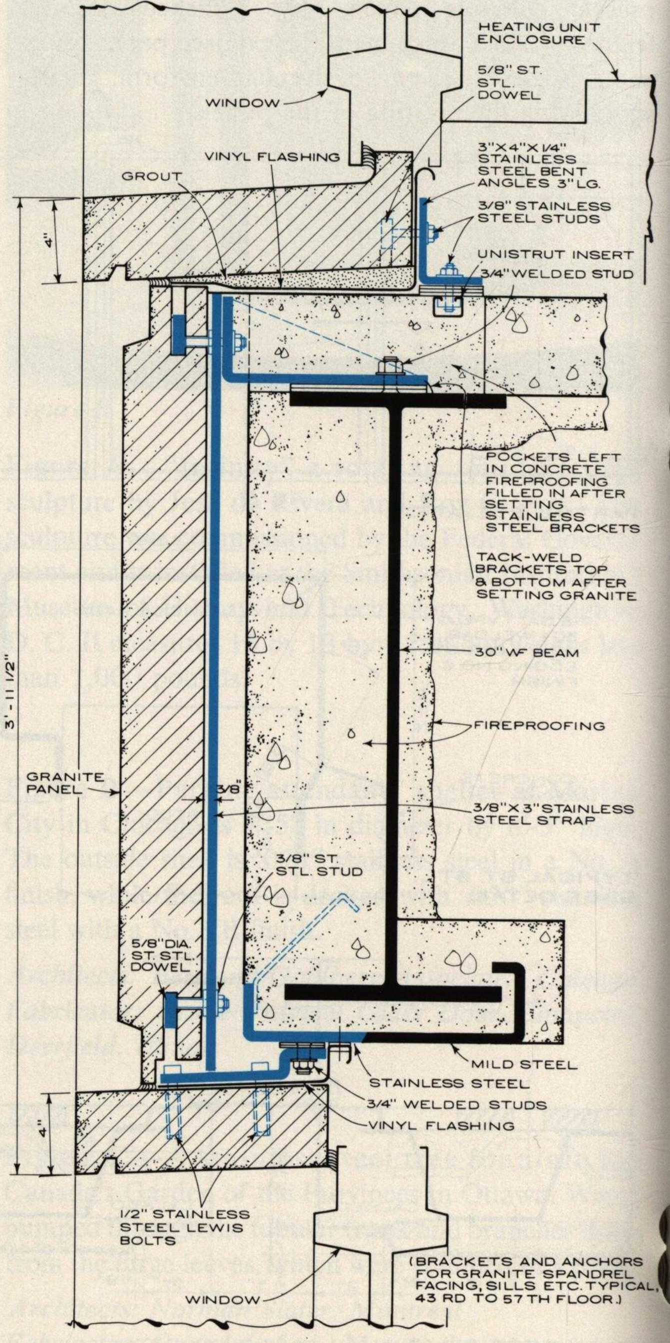
A variety of standard stone anchors has been designed to satisfy common attachment conditions for masonry components. These anchors are offered in a number of metals including hot galvanized steel, aluminum, eraydo zinc, yellow brass, commercial bronze and 300-series stainless steel.

Hot dip galvanized steel is not suitable for installations where the lime in mortar in solution with water can come in contact with the metal. This solution can dissolve the zinc coating, permitting the steel to rust, with subsequent staining of the masonry and structural deterioration of the anchor. Aluminum is also vulnerable to alkaline attack unless carefully protected by a coating such as heavy bodied bituminous paint.

Among the more corrosion resistant metals, stainless steel offers the best combination of properties for use with masonry. These include high tensile strength, excellent atmospheric corrosion resistance and compatibility with masonry alkalinity. Stainless steel does not produce an oxide wash that can stain adjacent materials or attack other metals corrosively. Because of its high strength and stiffness, anchors of stainless steel are less expensive than anchors of comparable strength

of eraydo zinc or commercial bronze. For these reasons stainless steel is recommended as the preferred material for stone anchors by both stone quarriers and fabricators and stone anchor manufacturers.

In the installation detailed below, custom fabricated stainless steel anchors were used to attach the spandrel panels and column covers of pearl gray granite to the building structure. Anchoring components include angles, brackets and straps fabricated from stainless steel plate as well as a variety of stainless fasteners including bolts, washers, nuts, dowels and studs.



VERTICAL SECTION THRU SPANDREL

PIPE & TUBE RAILINGS

TUBULAR HANDRAILS: Ornamental grade thin-walled stainless steel tubing is an excellent material for the fabrication of railings. Round, square and rectangular tubing is stocked in a range of sizes and gauges. Ornamental tubing is also stocked (or available) in several mill-applied polished or buffed finishes, and is masked with paper or plastic film for protection during shipping and fabrication.

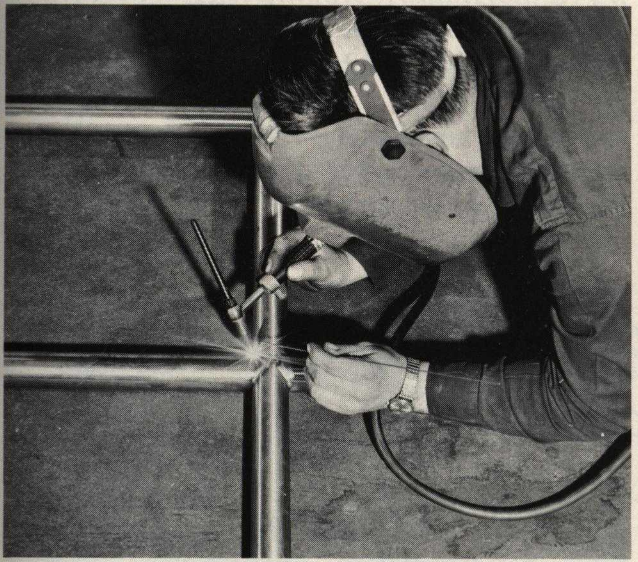


Figure A

High strength and stiffness permit the use of relatively light gauge materials. For example, 16-gauge (.062″ wall) stainless steel tubing is approximately equal in strength to schedule 40 (.145″ wall) aluminum pipe of the same diameter. Further, the tensile strength of stainless steel, unlike aluminum, is relatively unaffected by welding heat.

Fabrication is done using conventional cutting and welding techniques. (See Figure A) After assembly, the welded joints can be ground and polished to blend with the original finish. Handrails of stainless steel tubing require no chemical or electrochemical finishes for protection from corrosion or to enhance appearance. Initial economy and savings in maintenance costs provide a high return on investment dollars for the owner.

Figure B

Manufacturer: Stain-Rail Systems, Inc., Metuchen, N. J.

Low cost fittings and other components are also available from warehouse stocks. High strength railings can easily be assembled using structural adhesives (Figure B), which eliminates the need for refinishing after assembly. The system shown provides for either socket joints or flush butt joints.

BRAKE FORMED HANDRAILS: Attractive railings can be constructed from brake formed custom shapes as shown in Figures C and D. These examples utilize welded studs to attach the railing caps. One method of forming railing terminals is shown in Figure E.

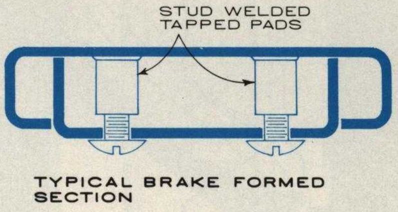


Figure C

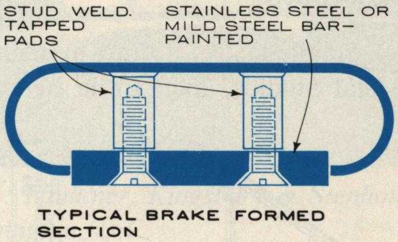


Figure D

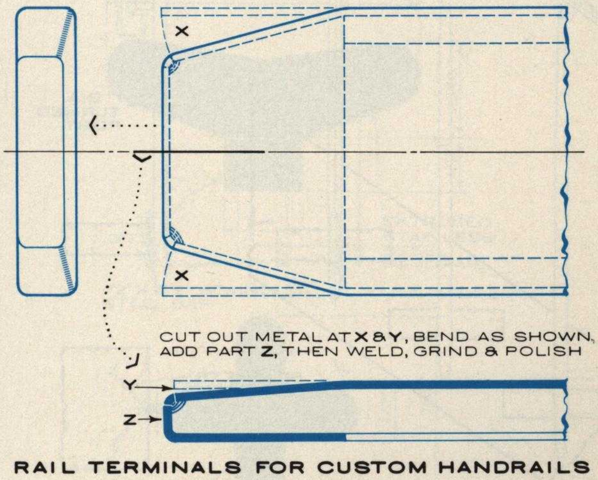
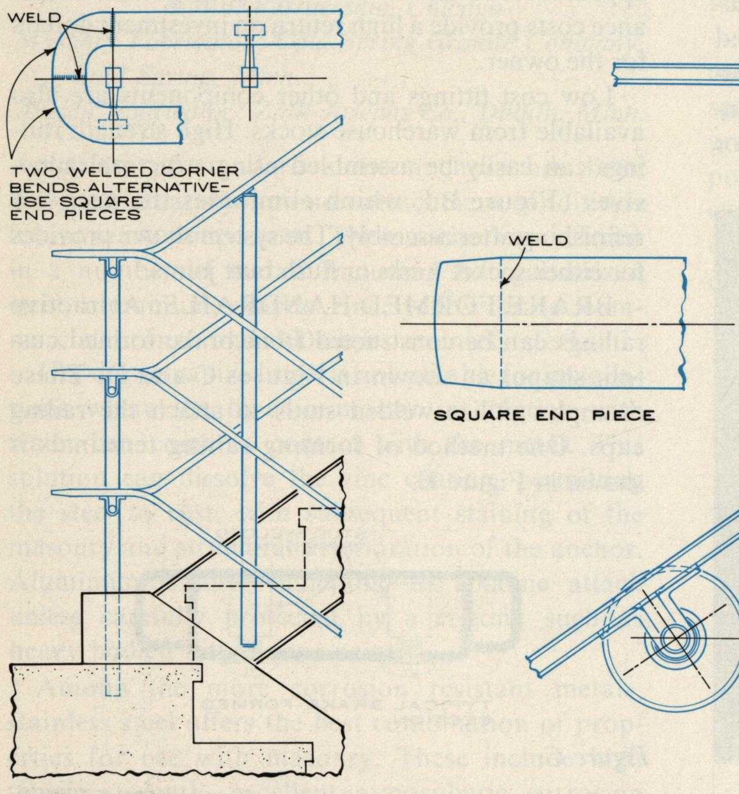


Figure E

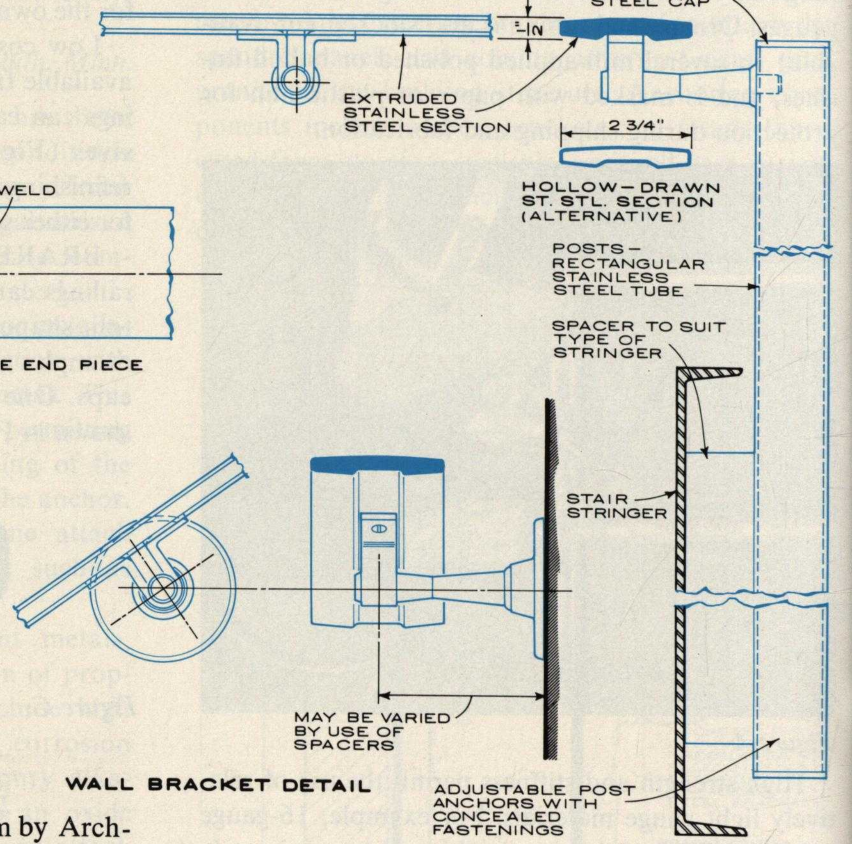
DIVISION 5

STANDARD RAILINGS

CARLSTADT Stainless Steel Railing System by Julius Blum & Company, Inc., Carlstadt, New Jersey

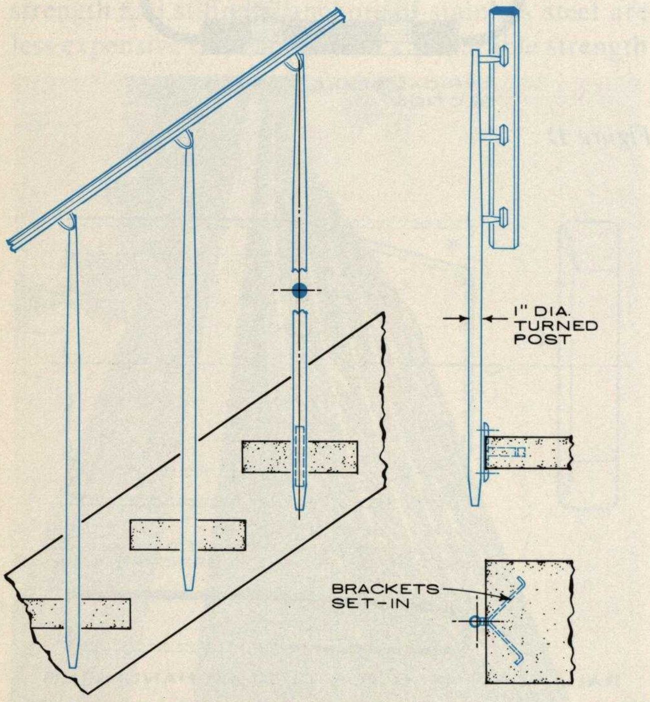


TYPICAL RAILING RETURN AT STAIR LANDING

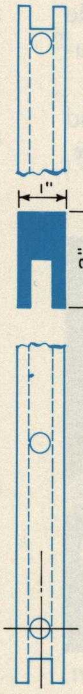


WALL BRACKET DETAIL

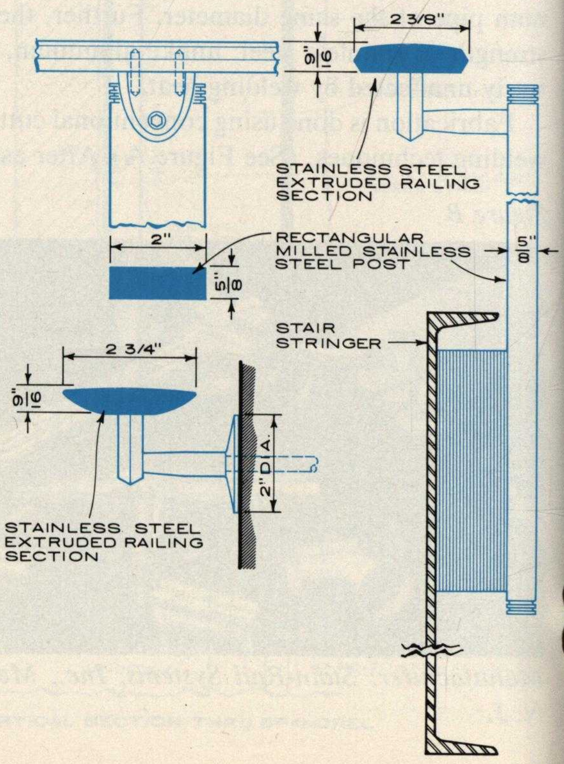
PACELINE Stainless Steel Railing System by Architectural Metal Studios, Inc., Little Ferry, N. J.



RAIL & POSTS WITH PRECAST CONCRETE STEPS



SLOTTED POST



STAIRS & STAIR COMPONENTS

All stair components in the United Engineering Center (at right) are made of stainless steel. Box stringers, treads, nosings, risers, platforms, newels, spindles, railings, anchors and other fittings were available in standard form or were custom fabricated.

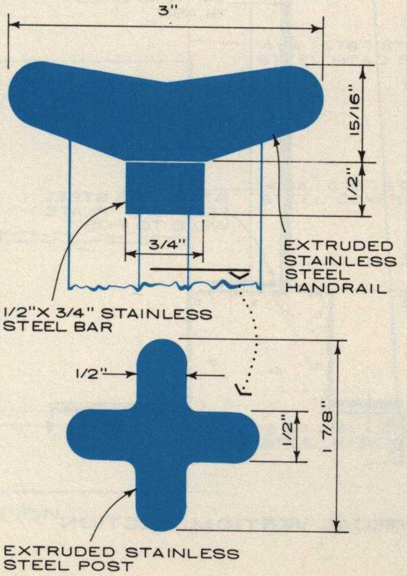
The graceful spiral stairs in the Brookings Institute Center for Advanced Study, Washington, D. C., (center right) are equipped with extruded stainless handrails, tubular intermediate rails and turned spindles.

Extruded stainless steel handrails and posts (shown in the photo below with details bottom right) are special features of a branch of the New York Bowery Savings Bank.

Designers: Gibbs & Hill, Inc., New York
Fabricator: Trio Industries, Inc., Bridgeport, Conn.

Architects: Shreve, Lamb & Harmon Associates, New York
Fabricator: General Bronze Architectural Products, Woodbury, L. I., New York

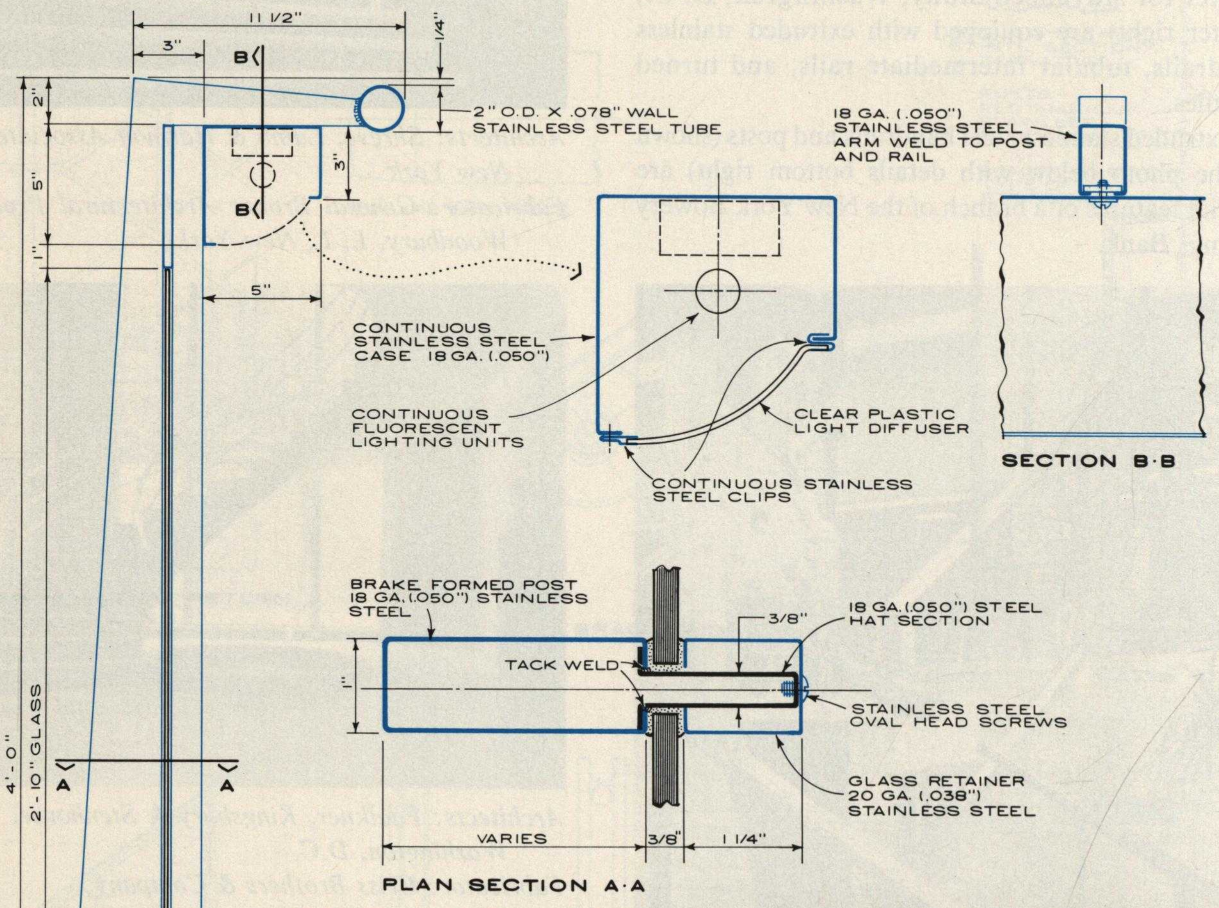
Architects: Faulkner, Kingsbury & Stenhouse, Washington, D.C.
Fabricator: Criss Brothers & Company, Bladensburg, Md.

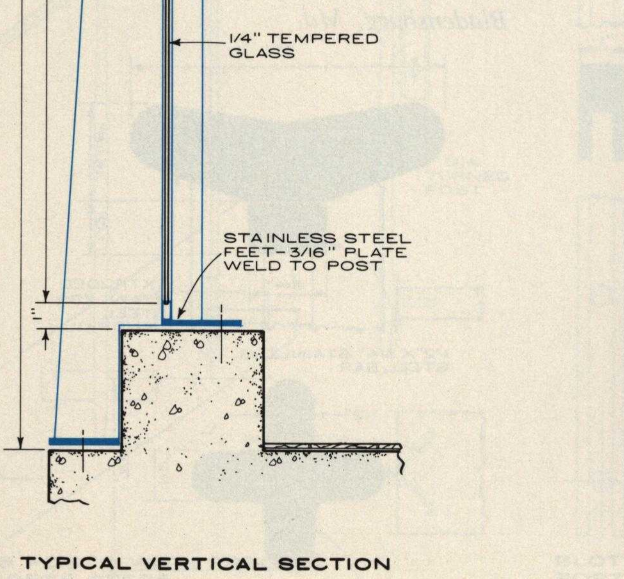


RAILINGS & BALUSTRADES

MONTREAL SUBWAY SYSTEM

The stations of Montreal's "Metro" were designed by fifteen independent architectural firms. The architects were provided with guidelines on space requirements and acceptable materials. Stainless steel was specified exclusively in all stations for railings, balustrades, turnstiles, doors, and many other items subject to heavy traffic. The balustrade (detailed and illustrated) was designed to give protection and lighting on the mezzanine crossover bridges, while those in other locations afford protection only.

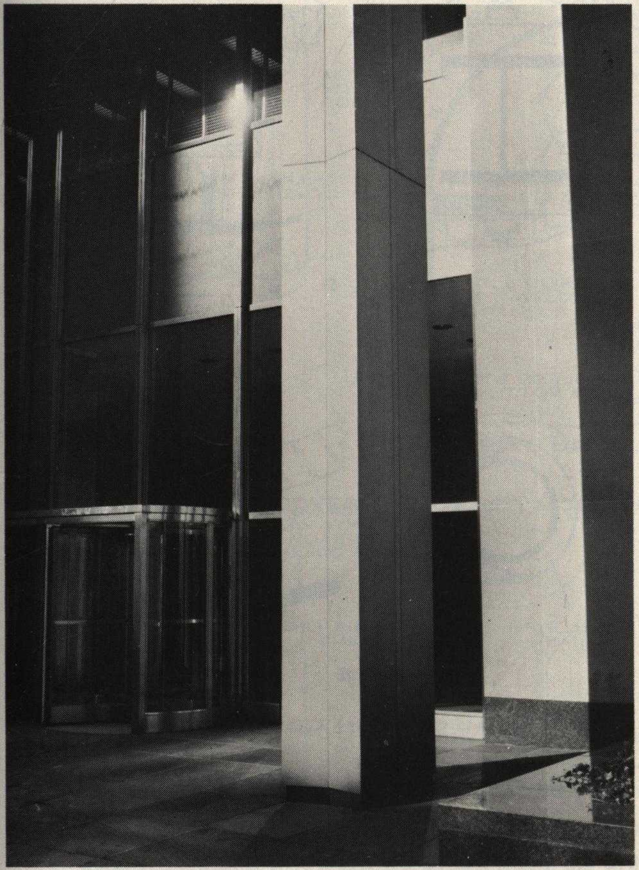




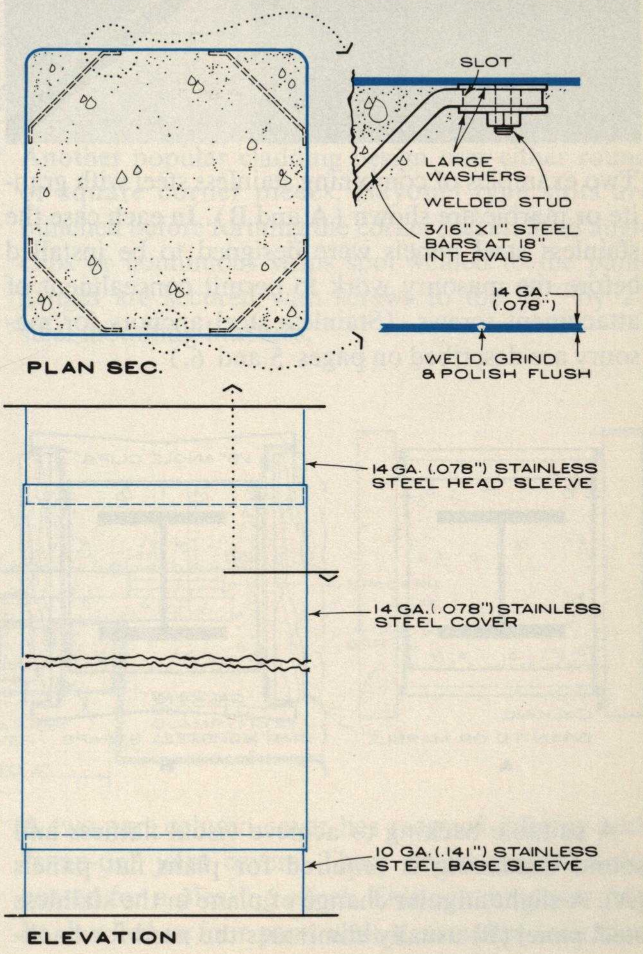
COLUMN COVERS

Columns of all shapes and sizes may be clad entirely with stainless steel or may combine stainless steel with other wear-resistant materials such as granite or marble. Important design considerations are visual flatness of plane surfaces and the concealment of fastenings.

The illustrations on the following pages show some of the methods employed to attain flatness and to conceal fastenings. The gauges of stainless steel specified depend on whether stiffening members or backing materials are used. Experience indicates that stiffening members should be spaced about 6″ apart for 20-gauge stainless steel and about double that interval for 16-gauge. Greater resistance to mechanical abuse is possible through use of stronger, higher moment sections, progressing from simple flat bar reinforcement to channel stiffeners or to a grid reinforcement for heavy traffic areas.



Backing materials bonded to the stainless steel also supply stiffness. This is the preferred method of controlling optical distortion of flat surfaces. Materials such as plywood, wood composition products, cement asbestos board, honeycomb and heavy-gauge mild steel sheets are used for backing. Refer to pages 20-22 in the Fabrication and Joining section.



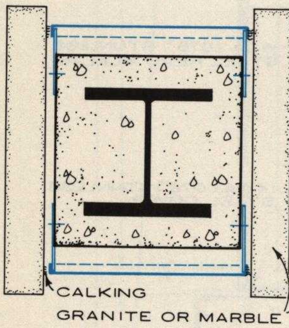
COLUMN COVERS

SUN LIFE INSURANCE CO., BALTIMORE, MD.

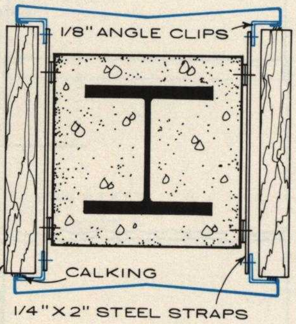
Architects: Peterson & Brickbauer, Baltimore; Emery Roth & Sons, New York

Fabricator: Allied Superb Bronze Co., Long Island City, N. Y.

Two examples of combining stainless steel with granite or marble are shown (A and B). In each case the stainless steel panels were designed to be installed before the masonry work to permit concealment of attachment screws. (Stainless steel anchors for masonry are described on pages 5 and 6.)

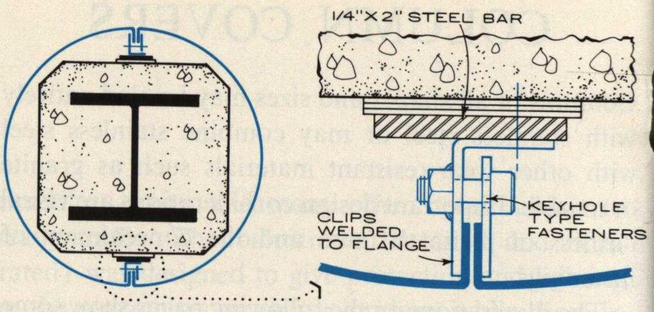


A

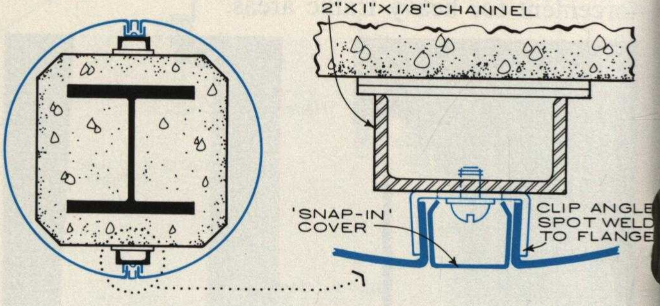


B

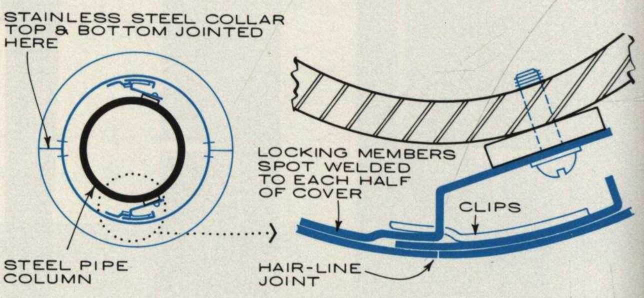
A suitable backing to achieve visual flatness and sound deadening is required for plain flat panels (A). A slight angular change of plane in the stainless steel panel (B) usually eliminates the need for backing. However, if sound deadening is desired, a mastic coating should be applied to the underside before installation. The stainless steel employed for these examples will vary from 12- to 20-gauge depending upon size and surface finish to be specified. The lighter gauges (18 and 20) are used only for fluted or patterned surfaces.



C



D

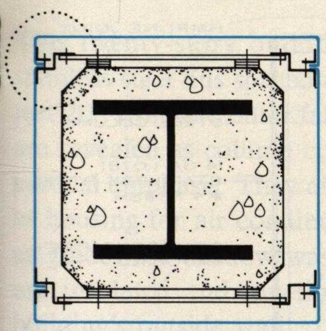


E

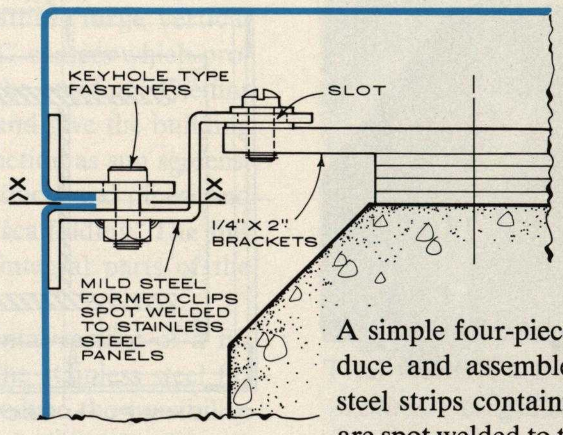
CYLINDRICAL COLUMN COVERS – PLAN SEC.

Cylindrical and oval column covers (C, D and E) offer many advantages for heavy traffic areas. There are no protruding corners and no flatness problems. They require no backing except for sound deadening, and they are more dent resistant. Gauges of stainless steel required vary according to column diameter from 12- to 18-gauge. Polished finishes, such as a No. 4 finish, with polish lines running either vertically or circumferentially, are most frequently specified.

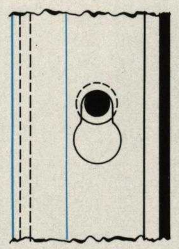
COLUMN COVERS



PLAN SECTION



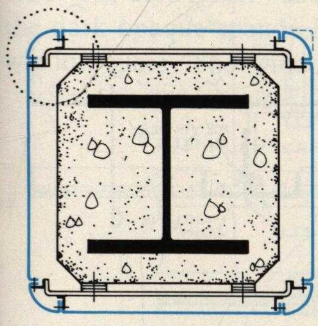
TYPICAL DETAIL



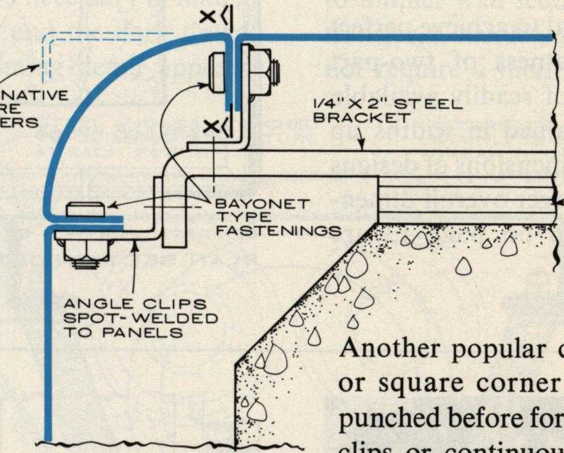
SECTION X·X

TYPICAL COLUMN COVERS – 4 PANEL TYPE

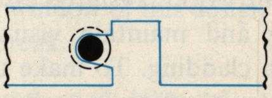
A simple four-piece cover arrangement, easy to produce and assemble, is shown. Clips or continuous steel strips containing "keyhole" fastening elements are spot welded to the panel flanges. Mounting brackets of ¼″ by 2″ steel are secured to the structural column or to its concrete fire protection as shown.



PLAN SECTION



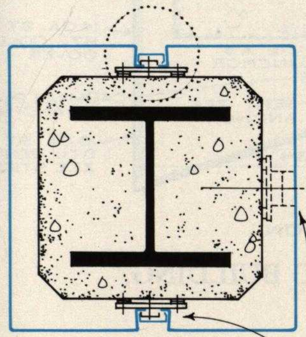
TYPICAL DETAIL



SECTION X·X

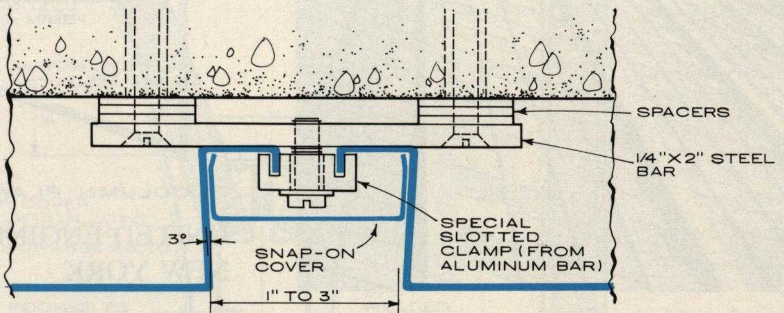
TYPICAL COLUMN COVERS – CORNER MOLDINGS

Another popular cladding design uses either round or square corner pieces. Bayonet-type slots are punched before forming the corner pieces. Steel angle clips or continuous strips spot welded to the panel flanges are secured with screws to the ¼″ by 2″ steel mounting brackets.



PLAN SECTION

JOINTS MAY BE USED ON BOTH AXES OF COLUMN



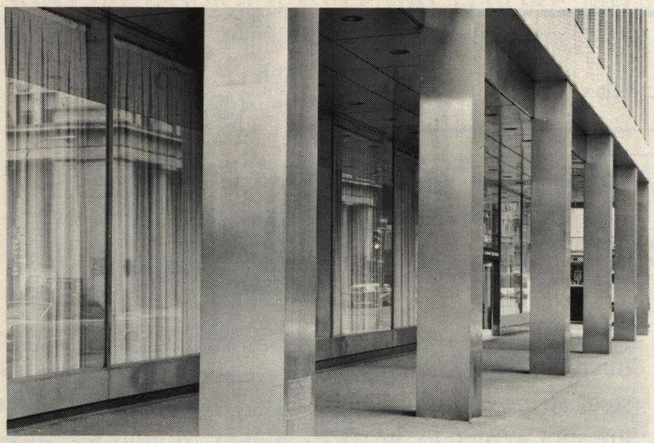
TYPICAL DETAIL

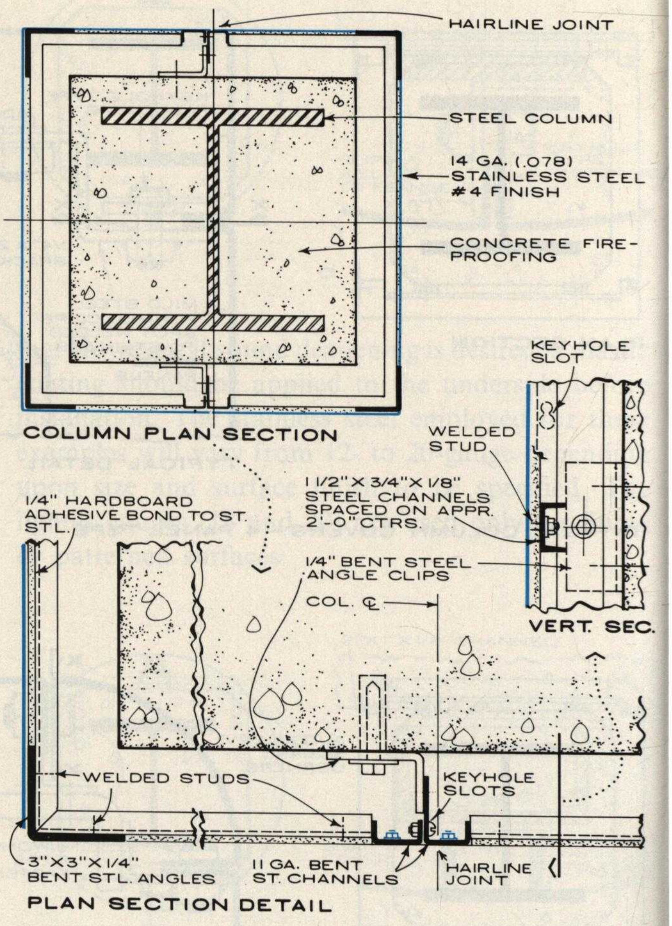
TYPICAL COLUMN COVERS – RECESSED JOINTS

A two-part column cover has recessed jointing with "snap-on" joint covers. These covers may be color coated for a pleasing effect. This column cover may be detailed in four parts with a recess on each face.

DIVISION 5

COLUMN COVERS



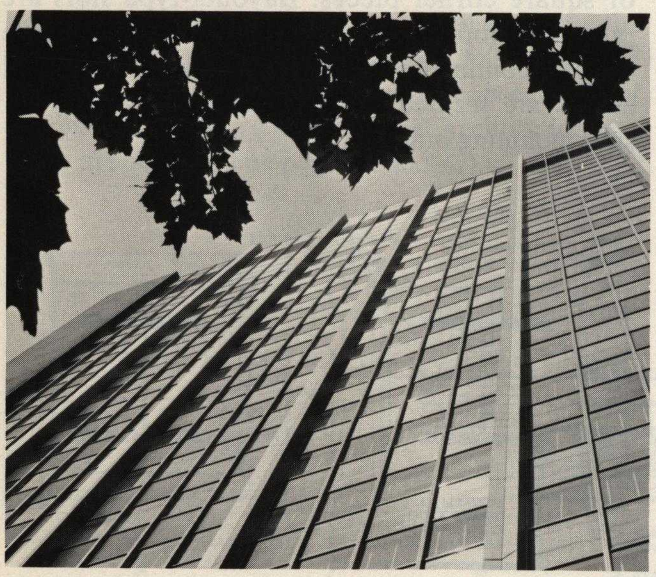


WESTERN ELECTRIC BUILDING, NEW YORK

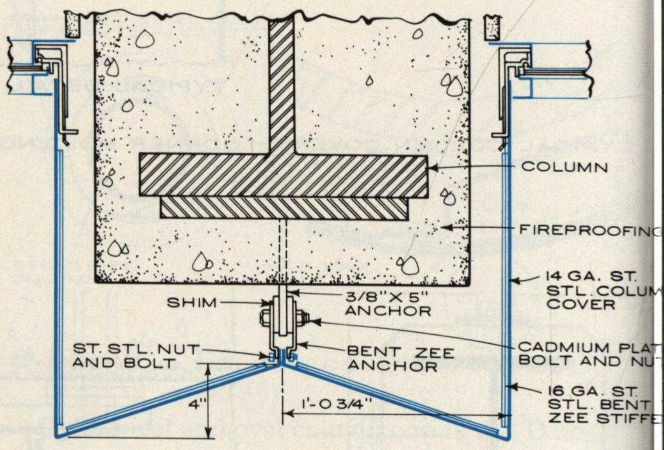
Architects: Shreve, Lamb & Harmon Associates, New York

Fabricator: Allied Superb Bronze Co., Long Island City, N. Y.

Accurate workmanship is essential to achieve perfect joining and maintain visual flatness of two-part column cladding. To make use of readily available sheet stock, which is easily obtained in widths up to 4 feet, the maximum outside dimensions of designs of this type should be 24″. For larger overall dimensions, the cladding types shown on page 13 are recommended.



Column covers for this installation are of 14-gauge stainless steel and are designed with a V-shaped profile. To improve visual flatness, the column covers are backed with 16-gauge bent Z-stiffeners and are finished with a matte architectural finish.



COLUMN PLAN SECTION

UNITED ENGINEERING BUILDING, NEW YORK

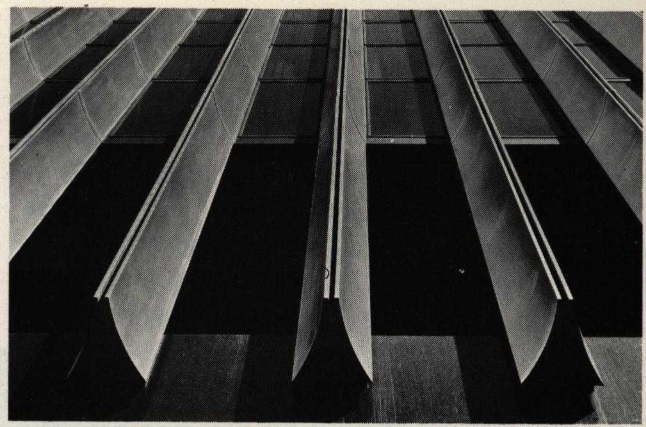
Architects: Shreve, Lamb & Harmon Associates, New York

Fabricator: Moynahan Bronze Company, Flat Rock, Mich.

COLUMN COVERS

This twenty-story building features large vertical stainless steel fins spaced at 4′-3″ centers which project 20″ from the outer face of the building. The fins are revealed as column covers and give the building vertical emphasis. They also function as sun screens, as housing for air conditioning ducts and pipes and as guides for window washers' scaffolding. The fins are insulated and function as integral parts of the building's outside wall.

Figure A illustrates a horizontal section of a fin showing construction details. The stainless steel fin covers have concave flanks to reduce the possibility of waviness and reduce light reflection. Horizontal joints, shown in the vertical section at the lower right of Figure A, are covered with 12-gauge stainless steel battens. Dark anodized aluminum windows and spandrel glass frames with a vinyl thermal break were used. The dark finish was deemed necessary to match the dark opaque spandrel glass and the dark tinted window glass. The window framing detail appears at the upper left of the drawing below. An alternate framing detail in stainless steel is also detailed. Due to thinner wall section and lower coefficient of heat transfer, a stainless steel window of this design would not require a thermal break.



THE OSBORN BUILDING, ST. PAUL, MINN.
Architect: Bergstedt, Wahlberg & Wold, Inc., St. Paul, Minn.
Fabricator: Flour City Architectural Metals, Minneapolis, Minn.

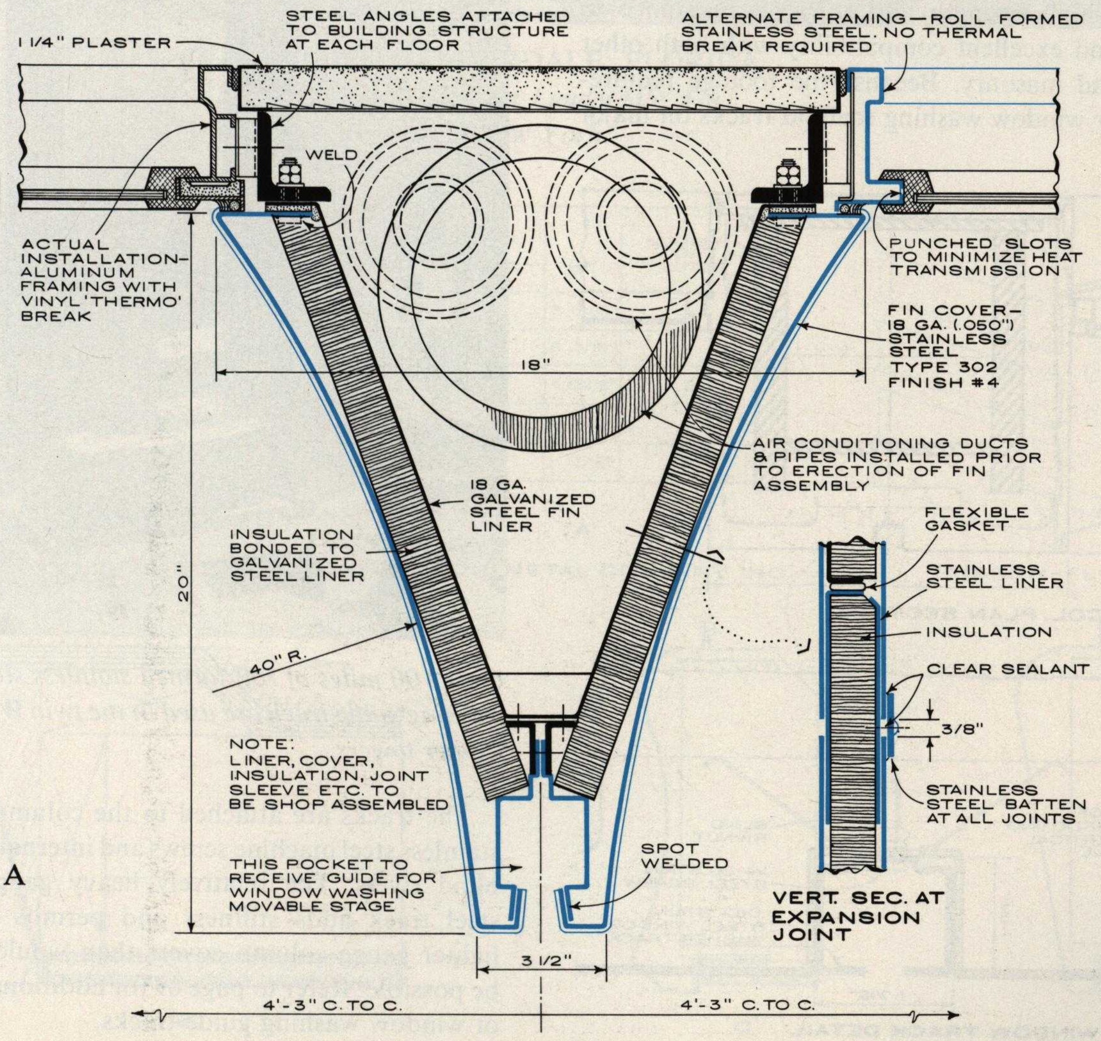


Figure A

PLAN SECTION THRU TYPICAL FIN

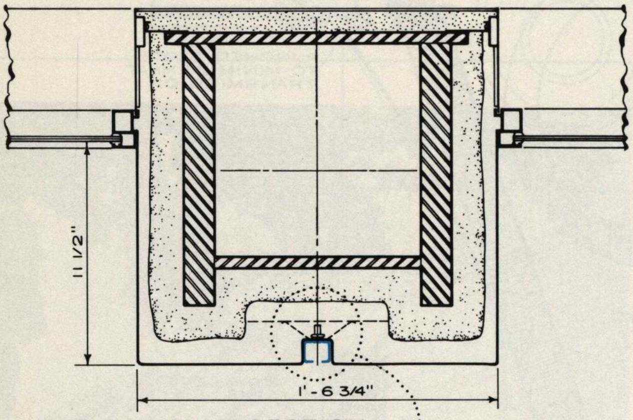
COLUMN COVER GUIDE TRACKS

WORLD TRADE CENTER, NEW YORK CITY
Architects: Minoru Yamasaki, Birmingham, Mich.
Emery Roth & Sons, New York
Fabricator: Cupples Products Division,
H. H. Robertson Company, St. Louis, Missouri
Roll Former: MEFCO, A Teledyne Company,
Elkhart, Indiana

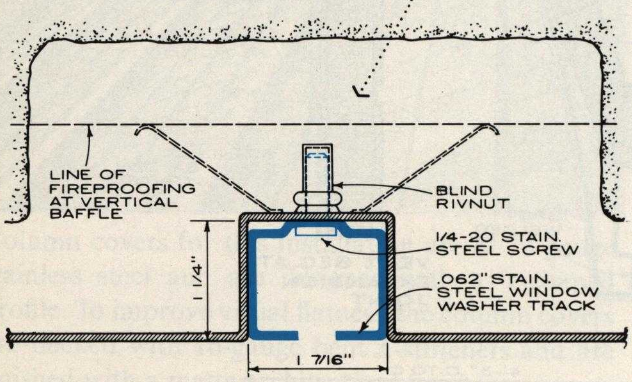
Window washing scaffolds have become a necessary adjunct to heavily glazed high rise buildings. However, absence of standardization in guide-roller or guide-shoe design and variation in methods of incorporating the track into the building facade and in attaching the track to the building structure have given rise to a diverse range of design applications.

Stainless steel has become a widely specified material for window washing scaffold guide tracks because of its corrosion resistance and low maintenance requirements. In addition, stainless steel provides high strength and stiffness, resistance to galling and excellent compatibility with both other metals and masonry. Because the footage requirements for window washing scaffold tracks on major projects are generally large, the sections for these installations are often most economically produced by roll forming.

The window washing guide tracks for the World Trade Center utilize a 16-gauge roll formed stainless steel shape which is mounted directly to the one-piece formed aluminum column covers. The recess for the window washing track divides the column face into vertical halves and reduces visual flatness problems. The bright annealed finish of the window washing tracks provide a reflective highlight against the matte finish of the column covers.



TYP. COL. PLAN SECTION



TYP. WINDOW TRACK DETAIL

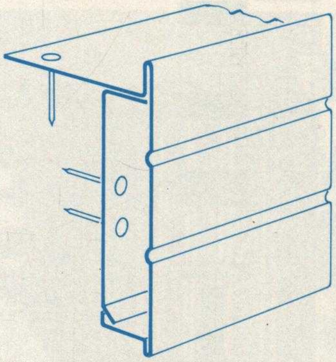
Over 100 miles of roll formed stainless steel window washing guide track are used in the twin World Trade Center towers.

The tracks are attached to the column covers by stainless steel machine screws and internally threaded blind rivets. The relatively heavy gauge stainless steel track adds stiffness and permits the use of lighter gauge column covers than would otherwise be possible. Refer to page 69 for additional examples of window washing guide tracks.

FACIAS

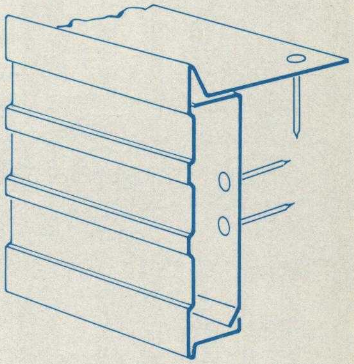
Examples of proprietary combination stainless steel facias and gravel stops are shown in Figure A and in the photo below. The fluted or ribbed face of this standard product eliminates the problem of waviness and permits the use of light 24-to 20-gauge thicknesses. Both designs are supplied with standard stainless steel anchor clips, inside and outside corner pieces and joint covers. Custom design suggestions are shown in Figures B, C, and D. Concave or convex surfaces reduce the possibility of waviness and have aesthetic appeal. Should plain surfaces be desired, use heavier gauges (18-to 14-gauge) or use a rigid backing. Textured sheet may also be used to reduce reflection and eliminate waviness.

BAYVIEW DENTAL CLINIC, FORT LAUDERDALE, FLORIDA
Architect: Charles F. McKirahan & Associates, Fort Lauderdale, Fla.
Manufacturer: Dawson Metal Co., Jamestown, New York



'FLO-LINE'

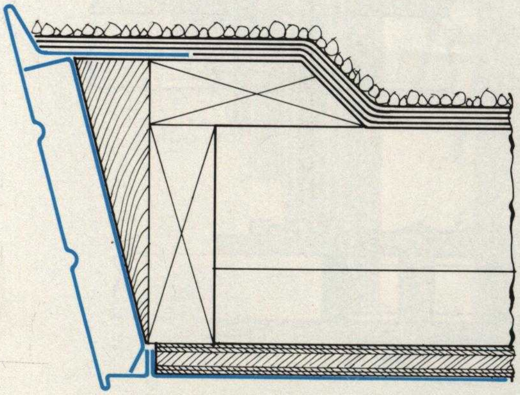
NUMBER OF FLUTES	HT.	NUMBER OF FLUTES
NONE	3 13/16"	1
1	5 13/16"	2
2	7 13/16"	3
2	9 13/16"	4
3	11 13/16"	5



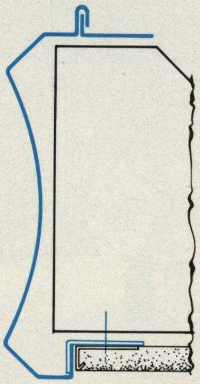
'RIBBON-FLO'

'A'

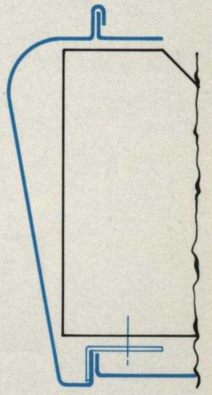
DAWSON METAL COMPANY INC.



'B'



'C'

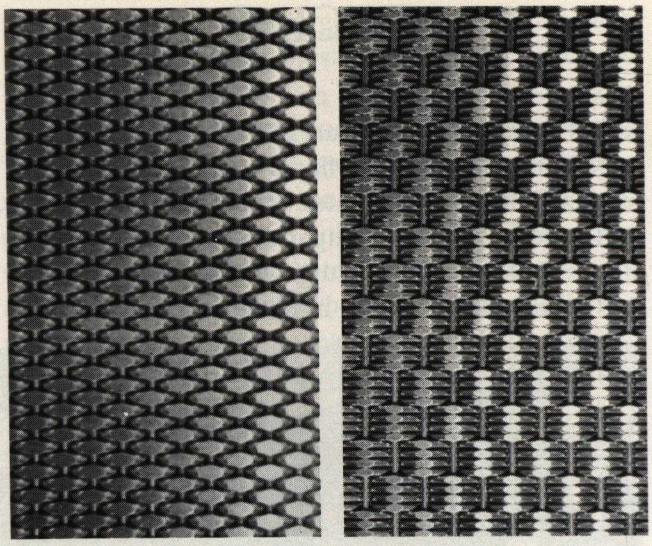


'D'

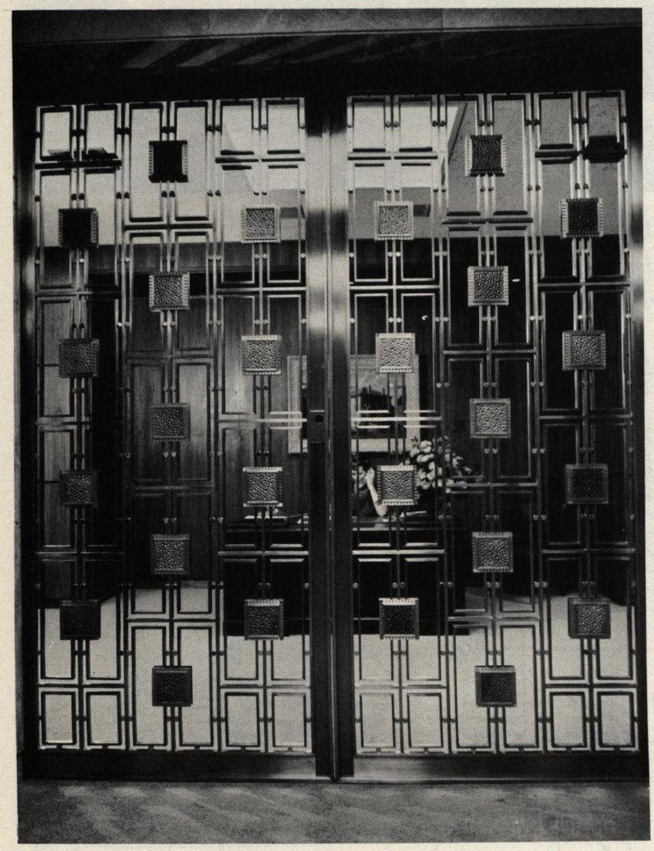
GRILLES

Stainless steel is highly suitable for use in fabricating grilles for doors, screens, partitions, and ventilators. An example is the custom designed grilles in the Bank of Montreal head office building, Montreal, Quebec, which combine stainless steel and bronze. Standard punched or woven stainless steel grilles are available in numerous patterns from many manufacturers.

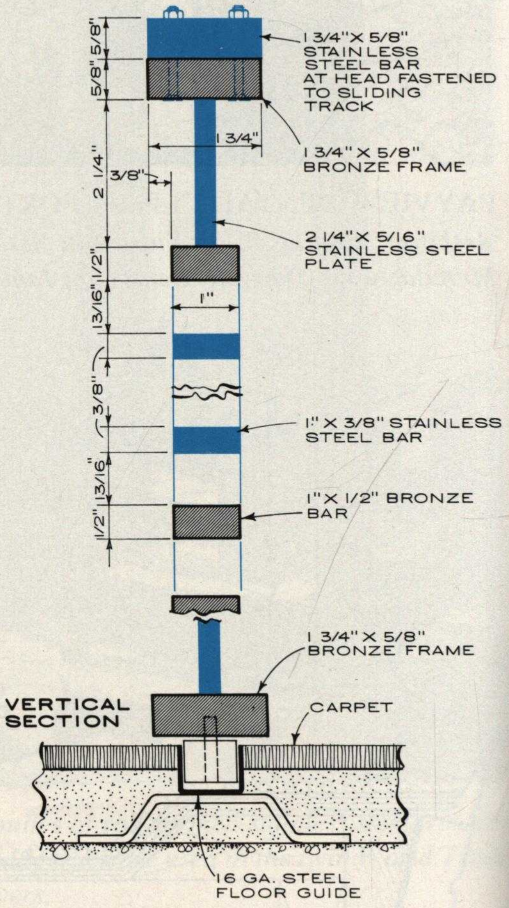
Illustrated at right are two of many available design patterns in woven stainless steel wire. Raised surfaces are highlighted by grinding and polishing. The textured surface minimizes the effects of wear and defacing, and the material is used extensively in elevator cars and entrances, push-pull plates, door facings, screens and grilles.

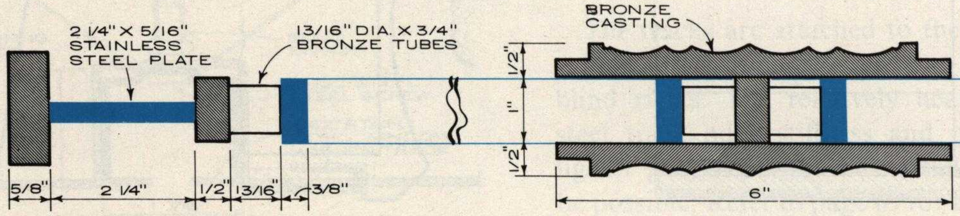


Ty-Glo Designs No. 72046 and No. 1404-S.
Manufacturer: The Tyler Company, Cleveland, Ohio



Fabricator: A. Faustin Ltd., Montreal





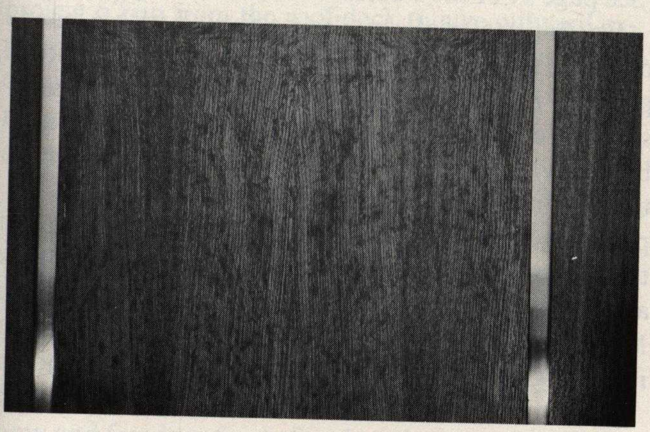
PARTIAL PLAN SECTION

CARPENTRY

CUSTOM WOODWORKING

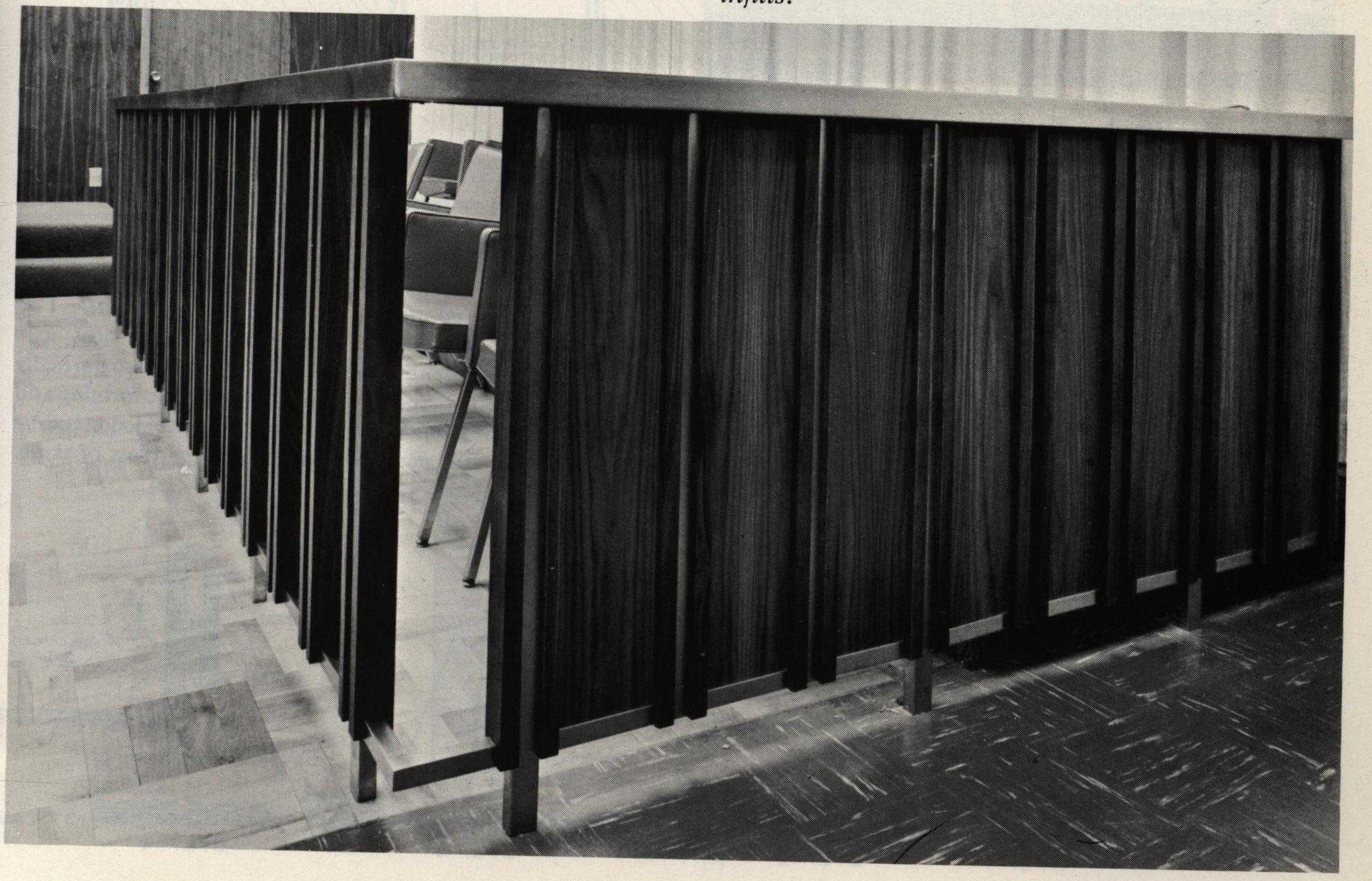
Stainless steel is often used very effectively in custom woodworking applications. Stainless steel shapes can provide structural support or a means of attachment for wood components, or stainless steel elements can be used to protect the more exposed wood areas from wear or damage. The visual contrast between the uniform luster of stainless steel and the warmth and richness of wood lends exceptional elegance to custom woodwork installations.

Polished stainless tubing forms door frames and acts as the supporting structure for walnut veneered partition panels. Mechanically fastened baseboards are formed from polished heavy gauge sheet.



Back batten effect is produced by recessed stainless strips separating narrow veneered panels in this wall installation.

Traffic control railing is formed from welded rectangular tubing with solid and veneered wood panel infills.

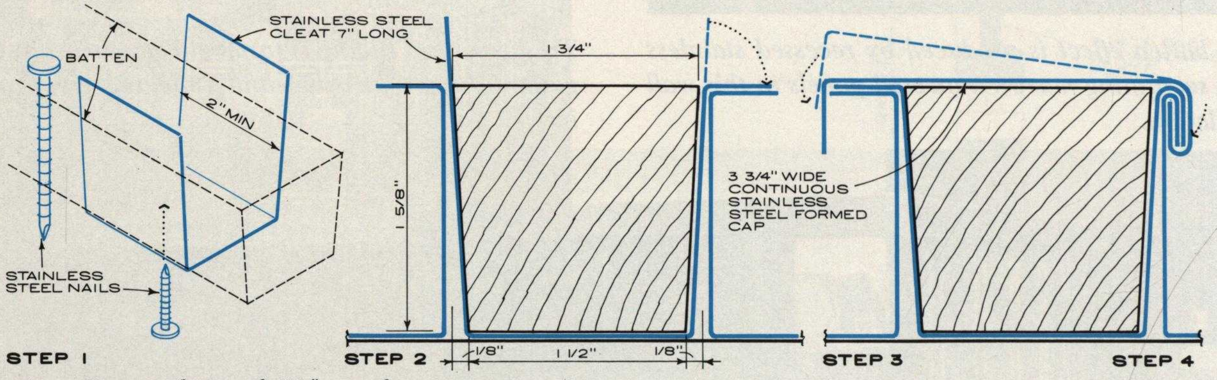


ROOFING

The use of stainless steel for roofing applications is by no means new; many installations, still in excellent condition, date back to the 1930's. Today, the increasing cost of maintenance and widespread existence of corrosive atmospheric environments make stainless steel roofing an ideal solution for many buildings. Roofs of stainless steel are extremely durable and require virtually no maintenance. Installation details are essentially the same as those used with other metals, although somewhat different joining techniques are used. Stainless steel is fully compatible with other building materials and does not produce a metallic oxide wash which can stain adjacent areas or galvanically attack other metals.

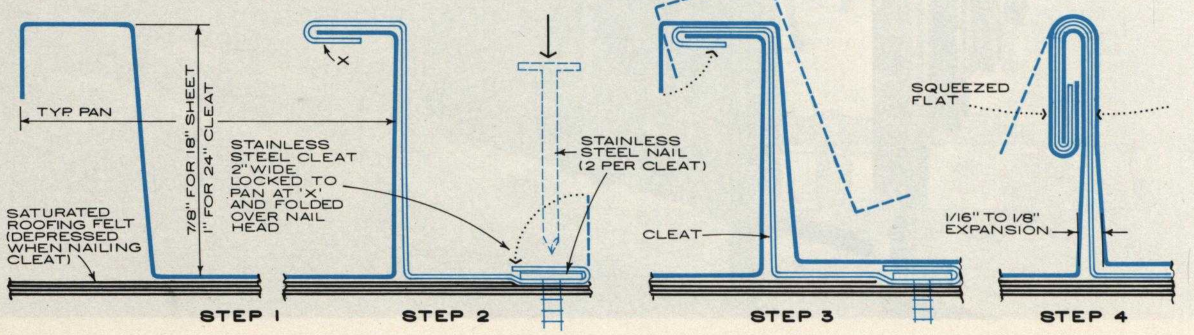
In addition to functional properties of strength and corrosion resistance, stainless steel is also specified for reasons of esthetics and economy. The material has a light, uniform hue which retains its pleasing appearance through time. Sheet roofing material is normally provided with a nondirectional No. 2D finish, although formed industrial roofing panels are sometimes available with a No. 2B finish. Because of its high strength stainless steel can be used in thinner gauges than other metals. Recommended thickness of material for standard roofing conditions is .015″. In the dead soft, fully annealed condition, Type 304 stainless steel is easily shop or field formed and is compatible with most standard sheet metal techniques, tools and workmanship. Soldering practice, however, differs slightly from that used with other architectural metals, and proper procedures must be followed to assure sound joints. (See page 17 of the Fabrication and Joining section.)

Roofing material can also be riveted with a hand operated riveter using stainless steel pop rivets. Little pressure is required because of the light gauge and softness of the material. Stainless steel roofing can be easily welded by several techniques, and continuous resistance seam roofing can be made by portable forming and welding equipment. Several typical roofing details are illustrated below. For additional information refer to the A.I.S I Data Manual of Suggested Practice for Roofing, Flashing and Copings.



Application: Use on slopes of 1½″ per foot or greater. A choice of batten shapes in either wood or metal is available. Battens are nailed to a wood or nailable roof deck with stainless steel nails or are bolted in place with countersunk stainless steel bolts. Stainless steel roof panels are shop brake formed. Cleats 2″ to 7″ in length are secured to the battens to attach panels and batten caps. Prefabricated stainless steel batten seam and Bermuda seam roofing systems are available from manufacturers.

Application: Use on slopes of 3″ per foot or greater. For economy, a ⅞″ seam height is used with 18″ wide sheet; a 1″ seam height is used with 24″ stock. Nailing cleats are normally spaced 12″ on center. Special proprietary portable forming and welding equipment can produce continuous welded standing seam roofs that are completely watertight regardless of slope.



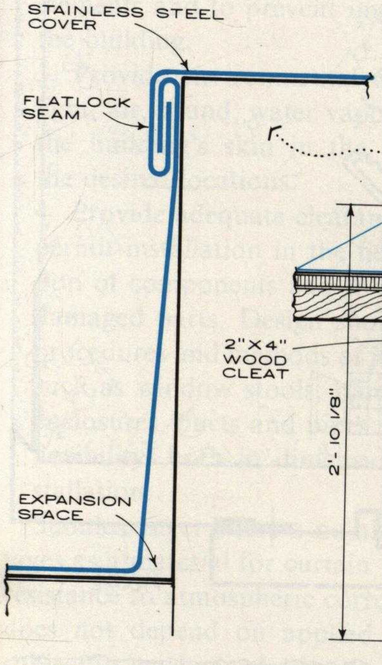
ROOFING

ST. FRANCES CABRINI CHURCH WEST BEND, WISCONSIN

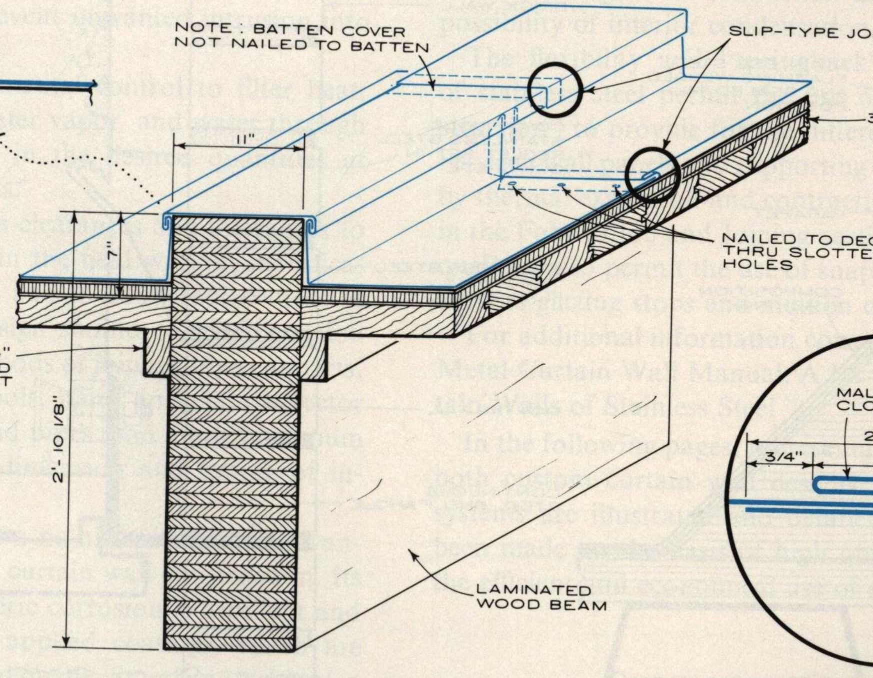
Architect: Brust & Brust, Milwaukee, Wisconsin
Fabricator: Reinke & Schomann, Milwaukee Wisconsin

The focal point of this church is the sweeping stainless steel roof, which soars up to a crown-like tower. The ribbed, semicircular roof and tower are of wood construction, with tongue-and-groove decking spanning between the curved, laminated bents. The bents project 6″ up from the roof deck to give outward expression to the strongly converging pattern which dominates the interior. The vertical rise also enables thermal movement to be accommodated by flexing, as indicated in the detail below.

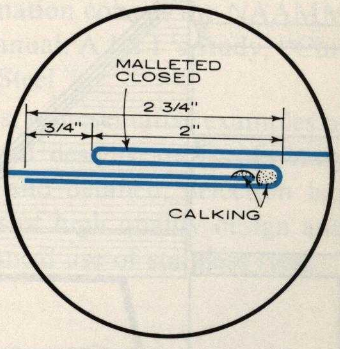
Fifteen thousand pounds of .015″ Type 304 full soft stainless steel sheet was used to clad the wood substructure. The modified Bermuda batten seam roof was applied unconventionally from top to bottom to avoid disturbing caulked joints or leaving discoloration from footprints. Stainless steel was selected for this installation because of its light color, economy and freedom from discoloration.



BATTEN DETAIL



TYPICAL ROOFING DETAIL



SLIP-TYPE JOINT

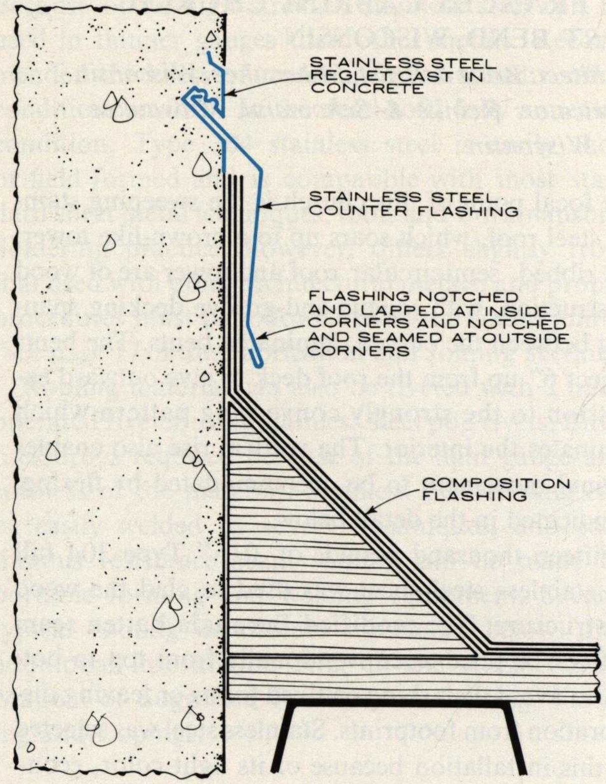
FLASHING

In recent years, the use of stainless steel flashing has increased considerably as more architects have become acquainted with the functional and economic advantages which stainless steel offers.

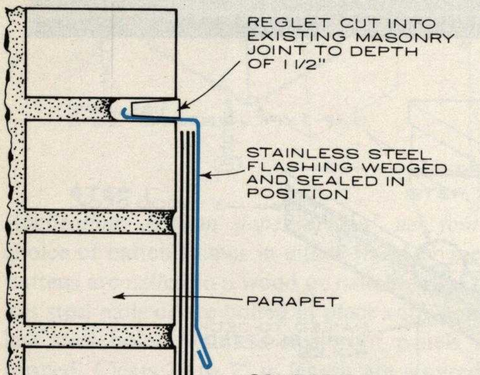
The details used for stainless steel flashing are essentially the same as those employed with other metals, although somewhat different joining techniques may be used and lighter gauges will normally be specified. Thicknesses generally recommended are .006″ to .015″ for concealed flashings and .012″ to .018″ for exposed flashings.

Stainless steel is not affected by the corrosive alkaline action of mortar or masonry and will not stain adjacent materials. In the fully annealed condition recommended for flashing applications, it is easily formed and can be soldered either in the shop or in the field.

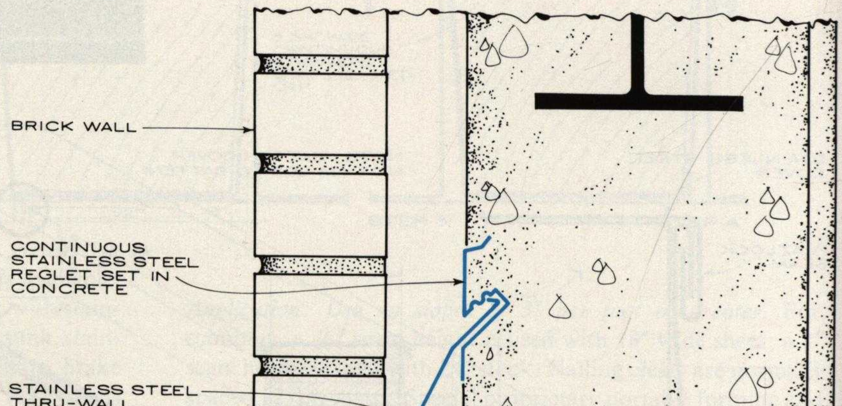
Soldering procedures for stainless steel differ somewhat from those used for other architectural metals. These procedures must be followed closely to produce sound joints and prevent corrosion. High tin solders are generally used to obtain good color match. Refer to page 17 in the Fabrication section for additional soldering information. Refer to A I S I 's Roofing and Flashing Data Manual for additional information on stainless steel flashing applications.



NEW CONSTRUCTION



EXISTING CONSTRUCTION



DETAIL AT WINDOW HEAD

CURTAIN WALLS

With the advent of the structural steel frame, the wall was freed from its traditional role as a means of structural support. For many years, however, only limited departures from traditional masonry construction were made in cladding skeleton frame buildings.

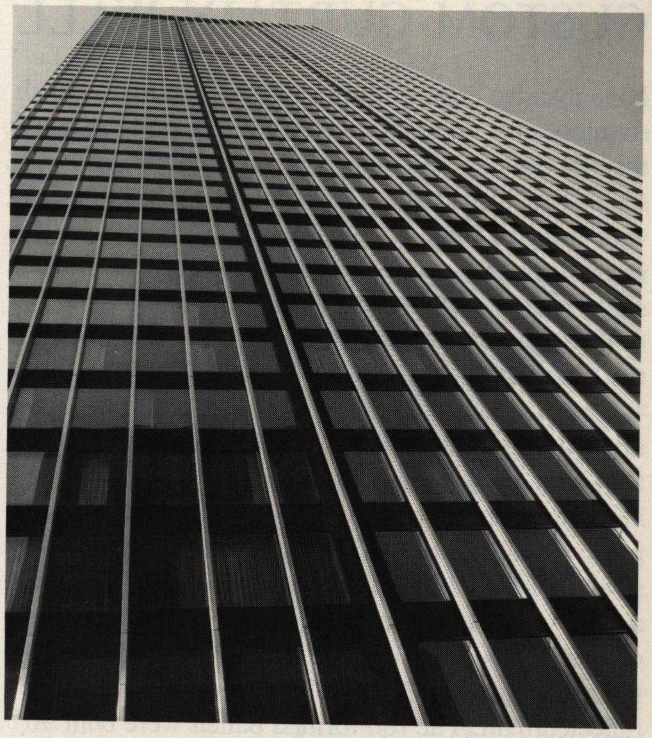
During the 1950's, the lightweight metal curtain wall was introduced into major commercial construction. This innovation brought about a revolution in architectural expression and altered the functional role of the wall. The curtain wall was seen to act as a "filter" rather than as a barrier, selectively controlling the entry and exit of traffic and environmental elements in accordance with the needs of the building's occupants.

The use of relatively light, elastic materials with high coefficients of thermal expansion compared to masonry makes the metal curtain wall a "dynamic" structure that moves in response to changes in temperature and wind pressure. This redefinition of the wall presented a new set of engineering problems and generated new materials requirements.

In order to evaluate design details, it is necessary to understand design principles and to view the curtain wall as an integrated functional element of the building. The curtain wall should be designed to:

1. Provide sufficient strength and stiffness to support dead loads imposed by the weight of wall panels and to resist wind loads.
2. Provide a barrier to withstand the action of the elements and to prevent unwanted intrusion into the building.
3. Provide environmental control to filter heat, light, air, sound, water vapor and water through the building's skin in the desired quantities at the desired locations.
4. Provide adequate clearances and tolerances to permit installation in the field without modification of components and to allow replacement of damaged parts. Design should consider erection procedures and methods of joining adjacent parts, such as window stools, blind pockets, convector enclosures, ducts and pipes and allow maximum flexibility, both in dimension and timing of installation.

Stainless steel offers a number of specific advantages as a material for curtain wall construction. Its resistance to atmospheric corrosion is excellent and does not depend on applied coatings, which are subject to mechanical damage. Stainless steel is also resistant to caustics in masonry and cementitious



fireproofing and is, therefore, practical for curtain wall components used in conjunction with these materials or exposed to them during erection.

The high strength and high modulus of elasticity of stainless steel make mullions of relatively small cross section practical. This aids the designer in minimizing exposed metal in curtain wall framing. When combined with the relatively low thermal conductivity of stainless steel, such designs greatly reduce through-wall conduction and minimize the possibility of interior condensation.

The flexibility and "springback" characteristics of stainless steel permit the use of "bellows construction" to provide for the differential movement between wall panels and supporting structure caused by thermal expansion and contraction. (See page 13 in the Fabrication and Joining section.) Springback qualities also permit the use of snap-in components, such as glazing stops and mullion covers.

For additional information consult the NAAMM Metal Curtain Wall Manual, A I S I 's study, "Curtain Walls of Stainless Steel ".

In the following pages, representative examples of both custom curtain wall designs and proprietary systems are illustrated and detailed. Selection has been made on the basis of high quality design and the efficient and economical use of stainless steel.

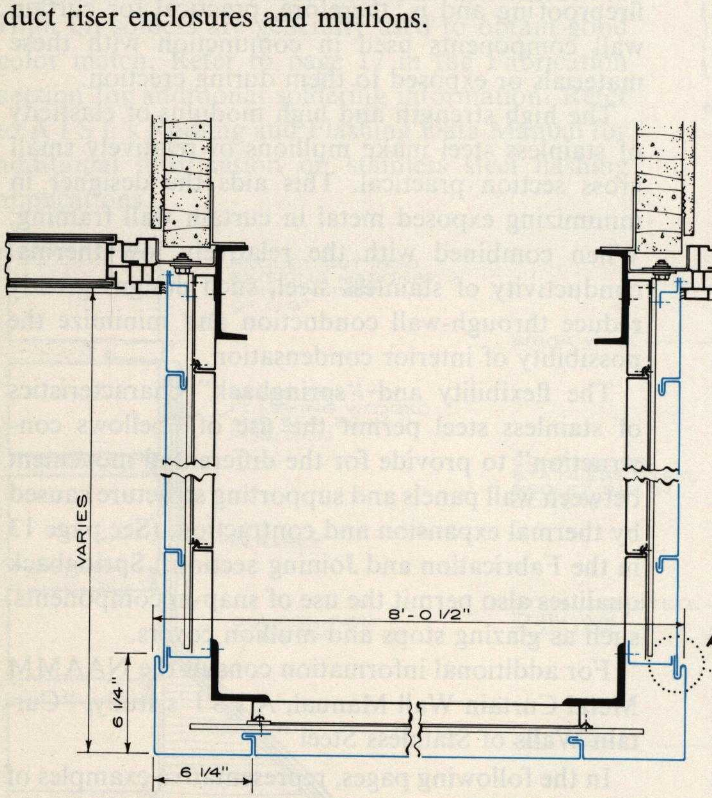
CUSTOM CURTAIN WALL

Nine massive exhaust duct enclosures in matte finish stainless steel dominate the east and west facades of this laboratory. Flexible utilization of laboratory space is achieved through modular interior design, with integral fume exhaust hoods leading from the interior to the 8-foot wide duct riser enclosures. The enclosures increase in depth to accommodate additional ducts as they ascend to the fan loft on top of the building.

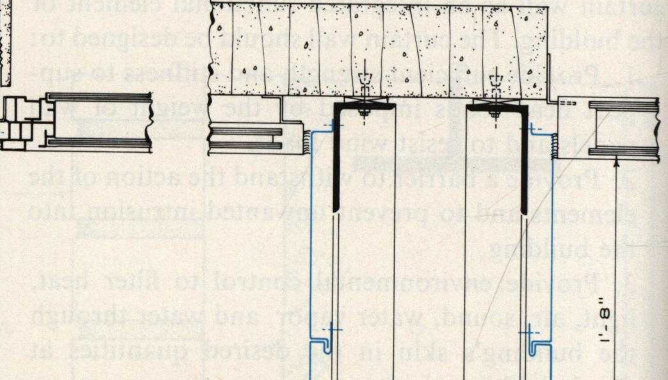
The duct enclosures are separated by windows and glass spandrels, which are divided into three vertical rows by two large projecting mullions. Both exhaust duct enclosures and mullions are fabricated from 18-gauge, nonreflecting matte finish stainless steel panels. The roll formed, interlocking panels are 12″ wide and are formed with an imperceptible convexity (1⁄16″ in 12″) to prevent any "pillowing" tendencies and to further increase the diffusion of reflected light. The roll formed panels were bent 90° in a press brake to form the corner sections for both duct riser enclosures and mullions.

HOFFMAN-LA ROCHE LABORATORIES
NUTLEY, NEW JERSEY

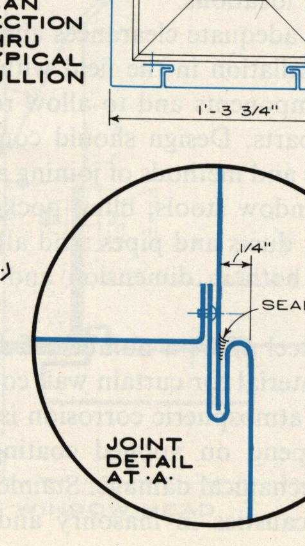
Architects: Haines, Lundberg & Waehler, New York
Fabricator: H. H. Robertson Company, Pittsburgh, Pa.



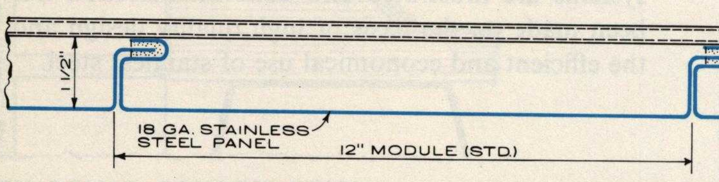
PLAN SECTION THRU EXTERIOR DUCT RISER



PLAN SECTION THRU TYPICAL MULLION



JOINT DETAIL AT A



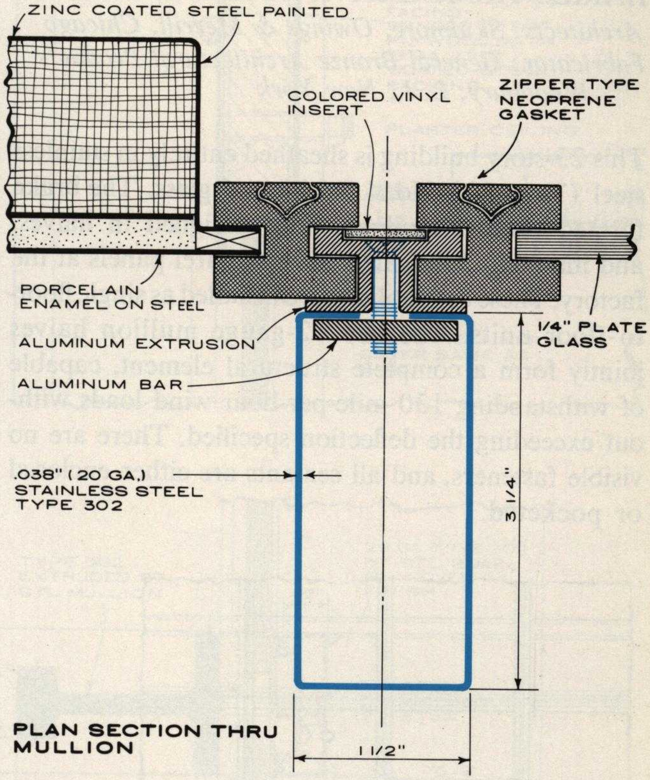
PLAN SECTION THRU TYPICAL EXTERIOR PANEL

CUSTOM CURTAIN WALL

A. C. NIELSEN BUILDING,
TORONTO, ONTARIO

Architects: Webb, Zerafa & Menkes, Toronto
Fabricator: Canadian Rogers Eastern Ltd., Toronto

This low cost custom design, which competed successfully with a proprietary aluminum curtain wall system, is suitable for low rise office buildings. A simple stainless steel framing arrangement contains insulated porcelain enameled panels and fixed plate glass windows. The mullions are fixed to structural steel continuous angles which form the top and bottom framing. These are clad with 22-gauge stainless steel with a No. 4 finish.

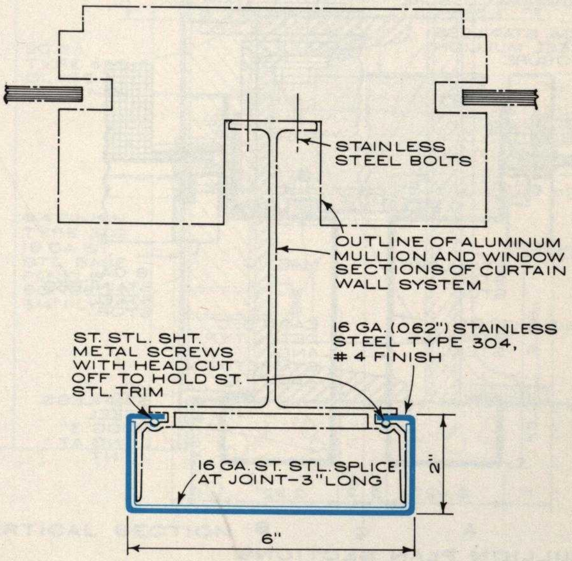


PLAN SECTION THRU MULLION

WESTVACO BUILDING, NEW YORK

Architects: Emery Roth & Sons, New York
Fabricator: Lupton Manufacturing Company, Philadelphia, Pa.

To add brightness and luster to this dark anodized aluminum curtain wall system, the major continuous vertical mullions on all facades were faced with stainless steel. The simple brake formed flanged channel and its method of securing are detailed.

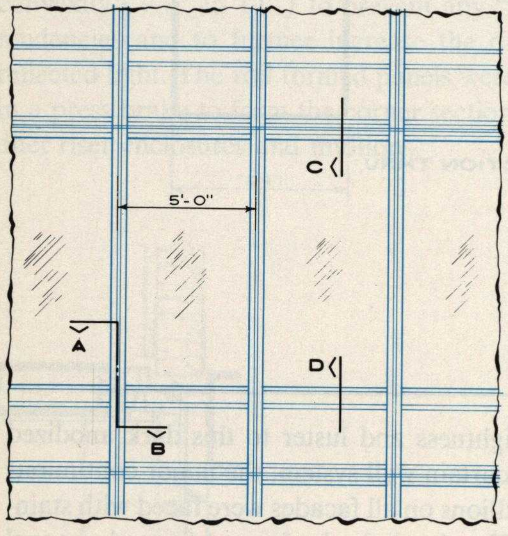


CUSTOM CURTAIN WALL

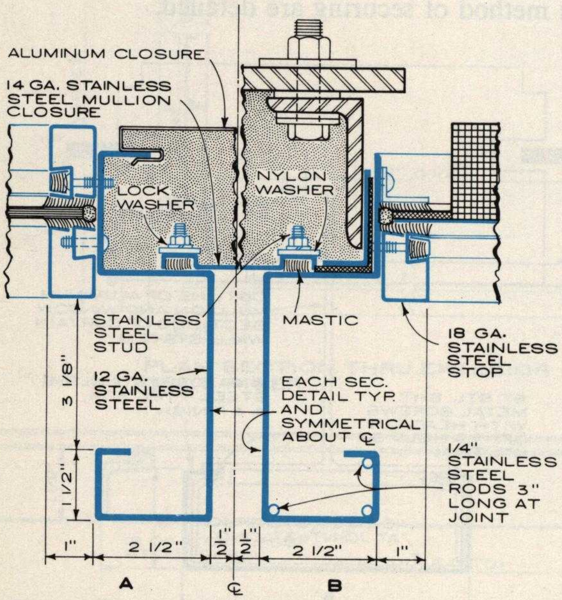
HARRIS TRUST & SAVINGS BANK, CHICAGO

Architects: Skidmore, Owings & Merrill, Chicago
Fabricator: General Bronze Architectural Products
Woodbury, L. I., New York

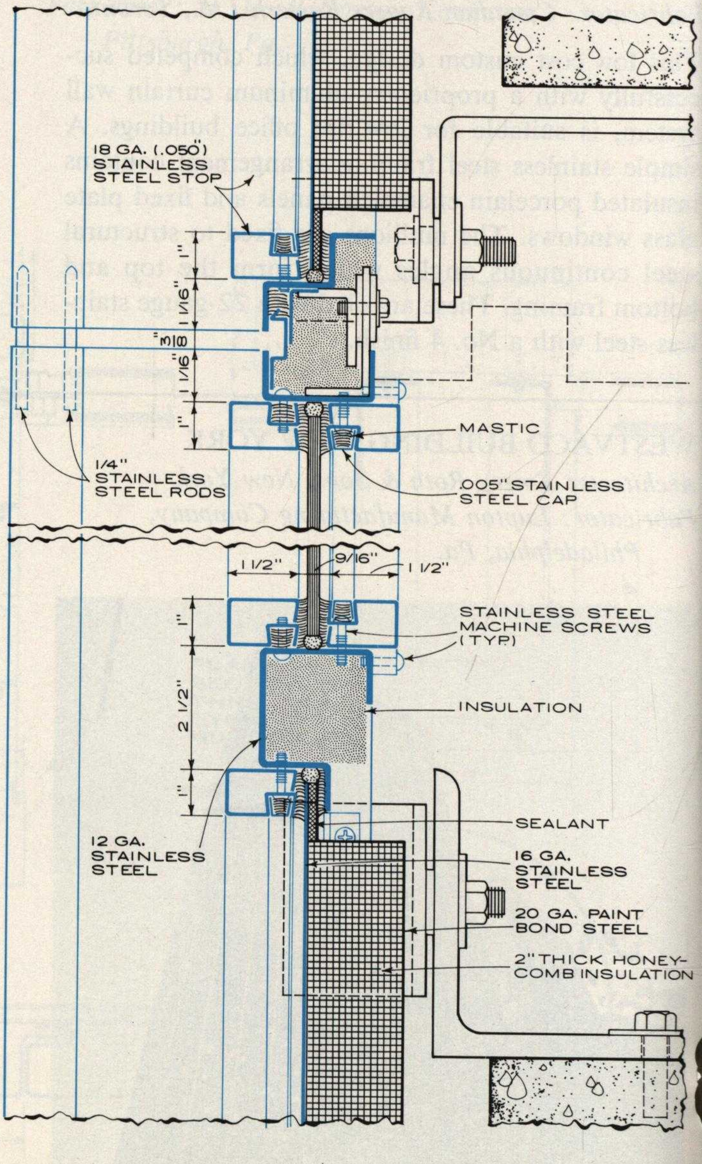
This 23-story building is sheathed entirely in stainless steel (Type 302, No. 4 finish) and glass. The brake formed vertical mullions were designed in halves, and integrally fabricated with spandrel panels at the factory. These assemblies were installed as single floor-to-floor units. The two 12-gauge mullion halves jointly form a complete structural element, capable of withstanding 130 mile-per-hour wind loads without exceeding the deflection specified. There are no visible fasteners, and all sealants are either enclosed or pocketed.



PARTIAL TYP. ELEVATION



MULLION PLAN SECTIONS



VERTICAL SECTIONS AT C·D

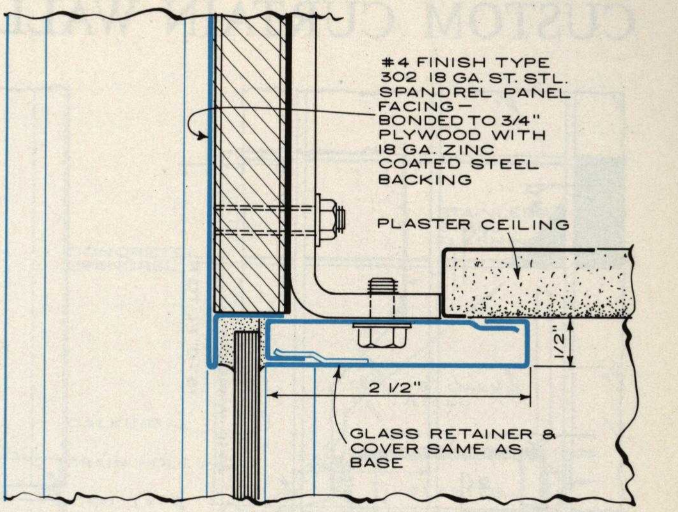
CUSTOM CURTAIN WALL

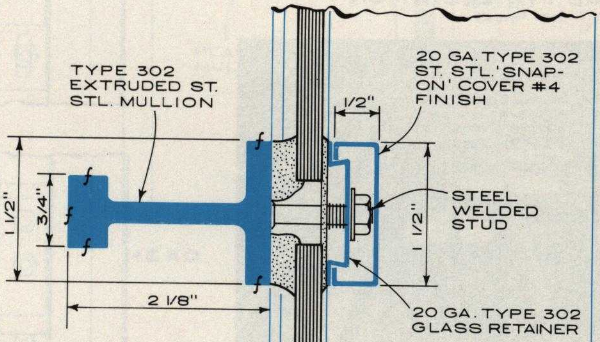
PITTSBURGH STEEL CREDIT UNION BUILDING, MONESSEN, PENNSYLVANIA

Architects: J. James Fillingham, Charleroi, Pa.
Fabricator: Architectural Metals Corporation, Canonsburg, Pa.

A unique feature of this simple curtain wall system is the use of slender extruded stainless steel mullions. Overall dimension of the I-shaped mullions are 1½″ wide by 2⅛″ deep. They are spaced at 3-foot centers and span approximately 8′-6″. An extended flange at the top and bottom of the spandrel panels provides a pocket for glazing. Inner glass retainers are attached to welded studs projecting from the back of the mullion. These are capped with snap-on covers as shown in the plan section. Welded studs are also used to anchor the extruded mullions to the structural steel framing (see vertical section).

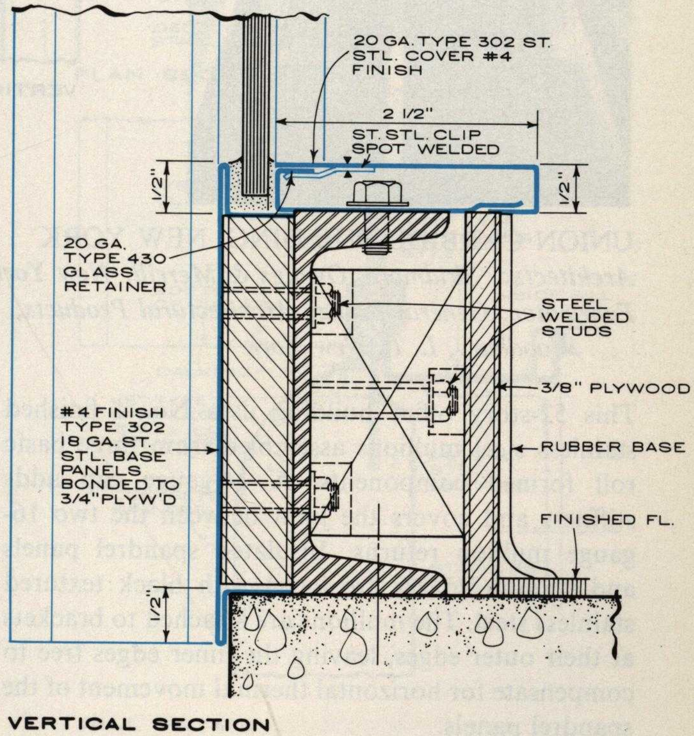
DIVISION 8





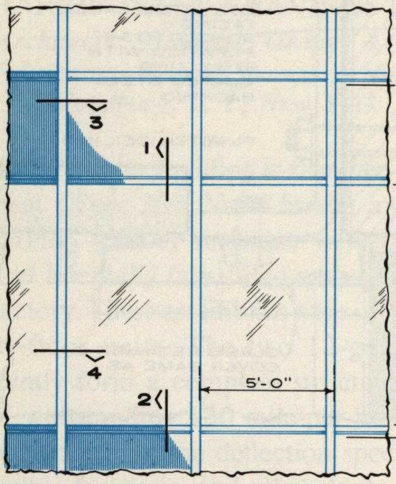
PLAN SEC.

f SURFACES POLISHED
OTHER " GRIT BLASTED

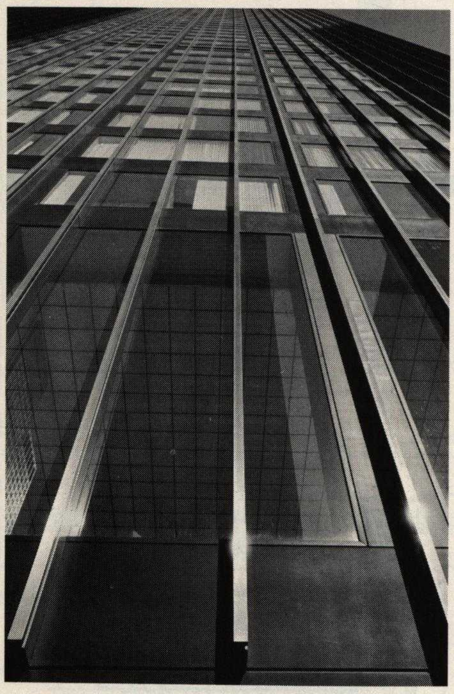


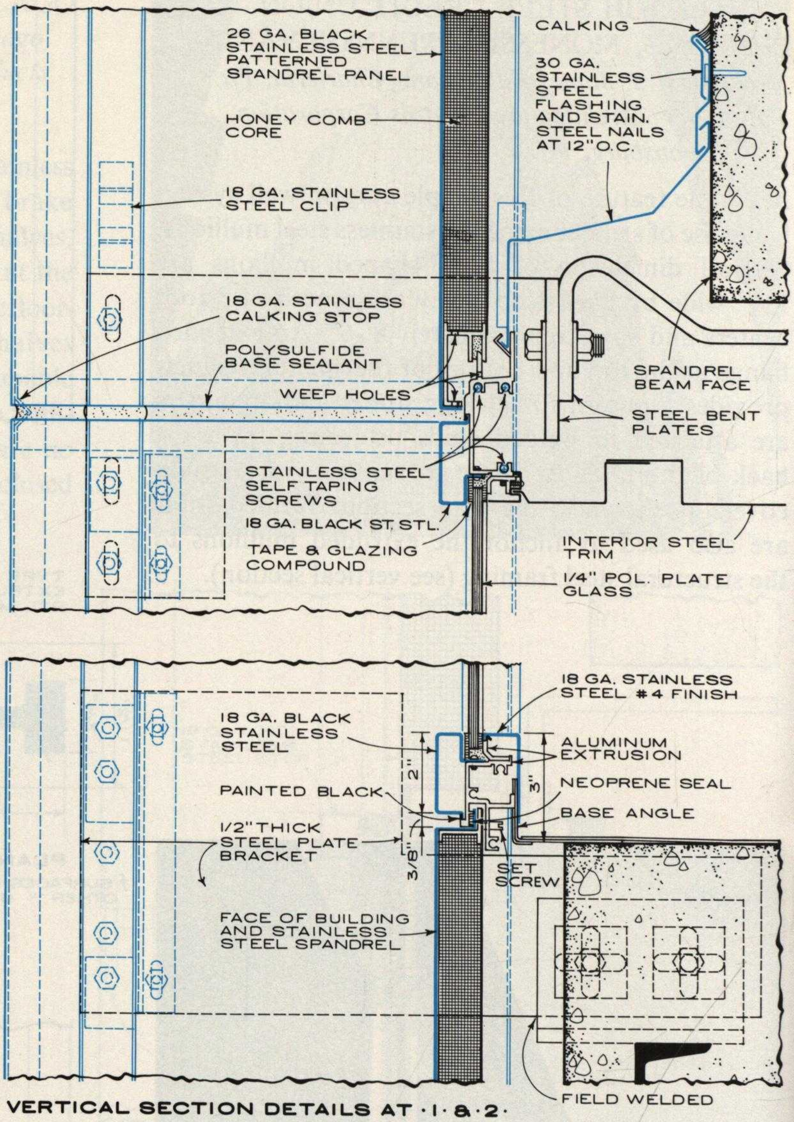
VERTICAL SECTION

CUSTOM CURTAIN WALL

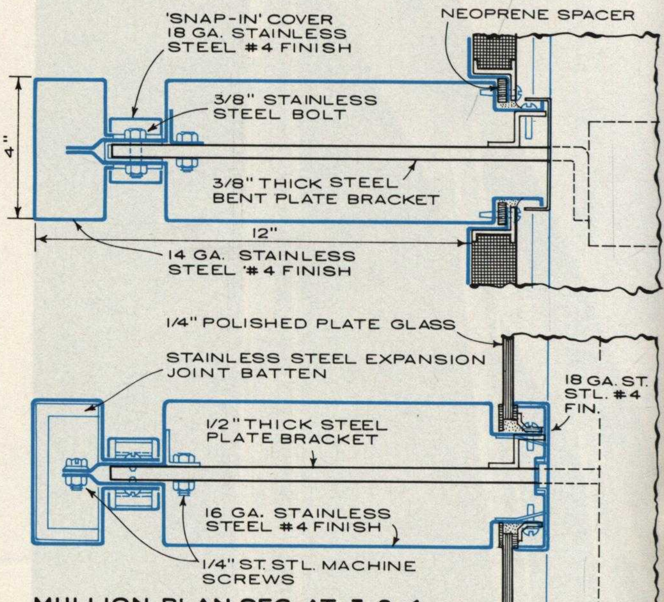


PARTIAL TYP. ELEVATION





VERTICAL SECTION DETAILS AT ·1· & ·2·



MULLION PLAN SEC. AT ·3· & ·4·

UNION CARBIDE BUILDING, NEW YORK

Architects: Skidmore, Owings & Merrill, New York
Fabricator: General Bronze Architectural Products, Woodbury, L. I., New York

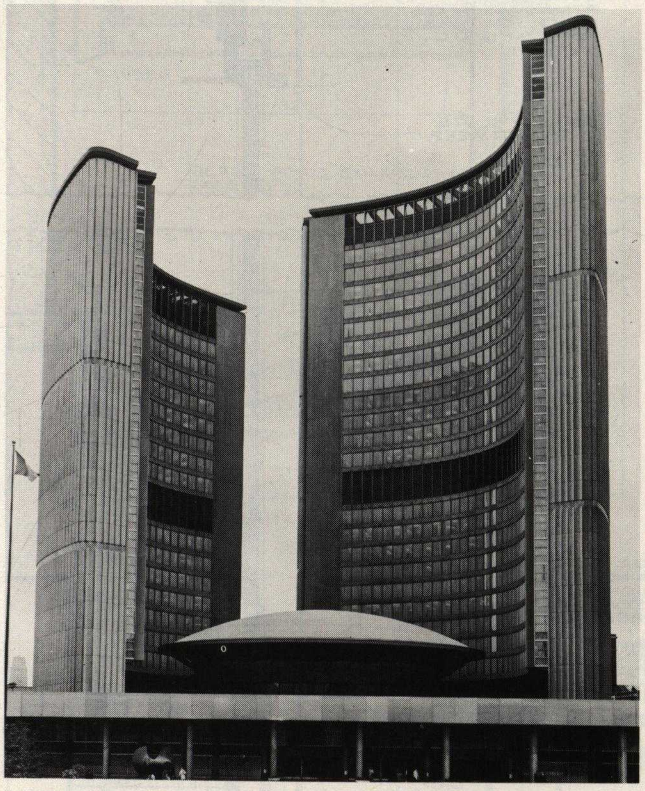
This 52-story office building uses No. 4 finished stainless steel mullions assembled from three basic roll formed components. A 14-gauge cap adds stiffness and covers the joint between the two 16-gauge mullion returns. Insulated spandrel panels and column covers are faced with black textured stainless steel. The mullions are attached to brackets at their outer edges, leaving the inner edges free to compensate for horizontal thermal movement of the spandrel panels.

CUSTOM CURTAIN WALL

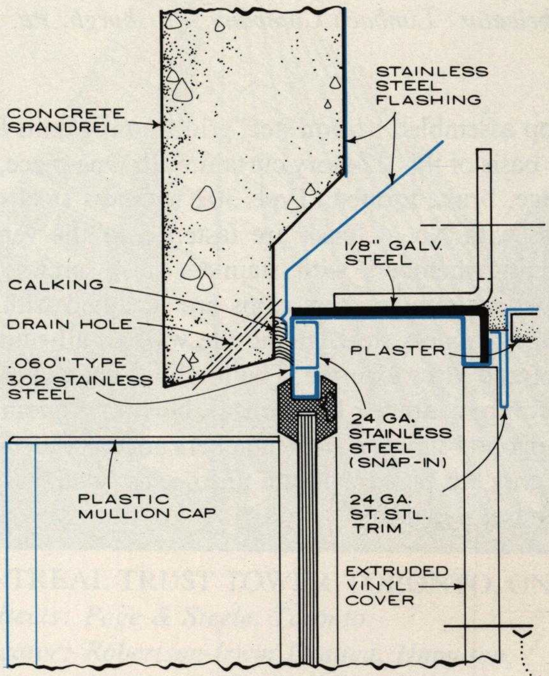
Window framing consists of simple brake formed sections of .060″ stainless steel with ⅛″ galvanized steel reinforcing members at head and sill. The head member is recessed to receive a venetian blind and the sill member serves as a condensation gutter. All corners are welded. Mullions were designed to compensate for both thermal movement (as bellows members) and curvature of the facade. They are attached to window jambs by studs welded to the mullion flanges. Nuts and washers are concealed by 28-gauge stainless steel "snap-in" covers on the inside. Interior flanges of adjoining window jambs are connected with slotted ⅛″ galvanized steel plates which are concealed by a black extruded vinyl cover. This cover also functions as a convenient vertical handrail for the sightseer.

On the mechanical floors, stainless steel louvers are installed in frames matching the window frames.

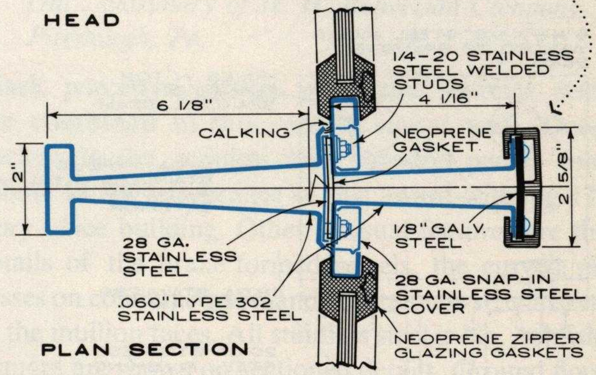
Except for the "snap-in" covers, all metal components of this unique, simple and economical design, were brake formed. All stainless steel is AISI Type 302 with a fine-line, polished finish.



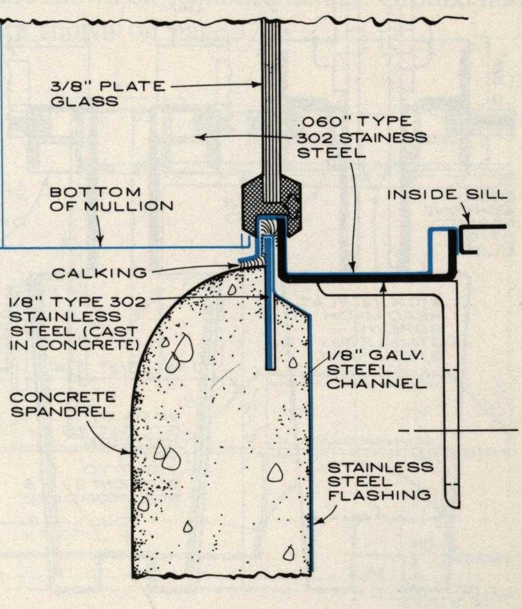
TORONTO CITY HALL, TORONTO, ONTARIO
Architects: Viljo Revell and John B. Parkin Associates, Toronto
Fabricator: Canadian Rogers Eastern Ltd., Toronto



HEAD



PLAN SECTION



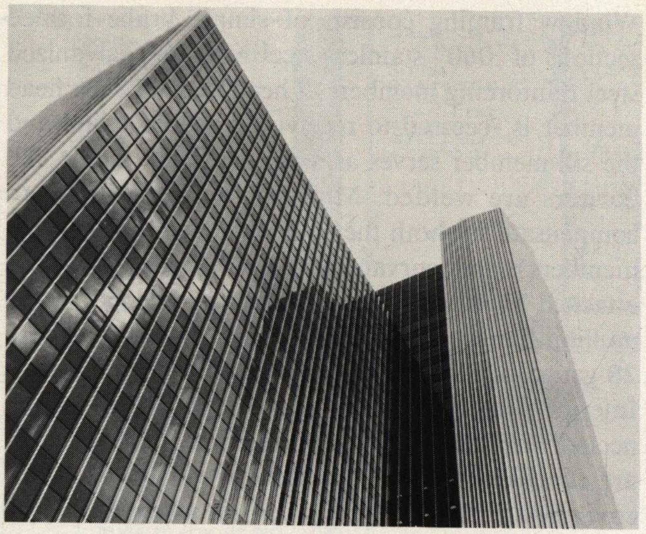
SILL DETAIL

DIVISION 8

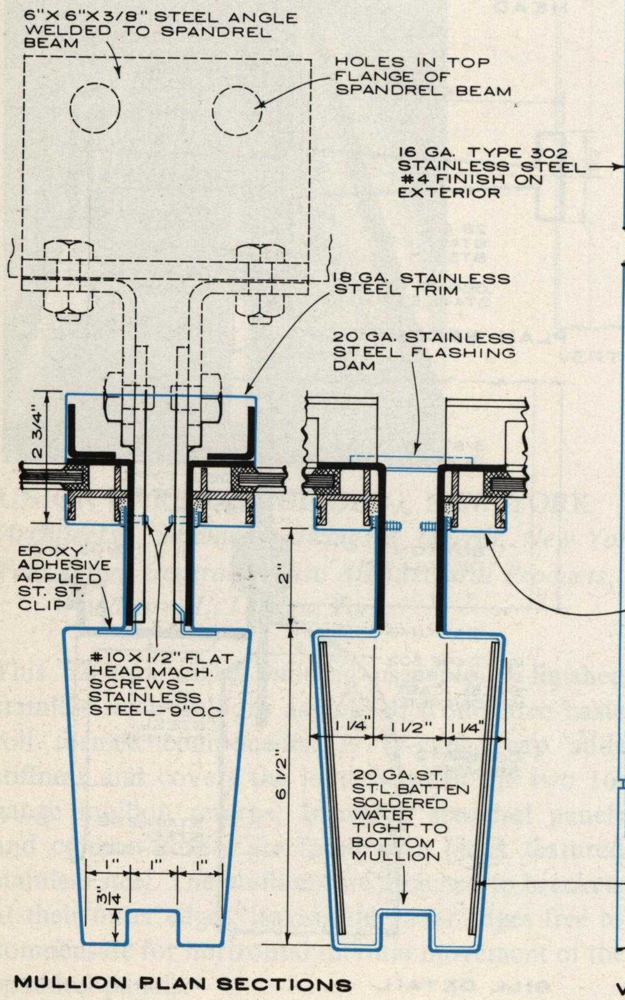
CUSTOM CURTAIN WALL

FOUR GATEWAY CENTER, PITTSBURGH

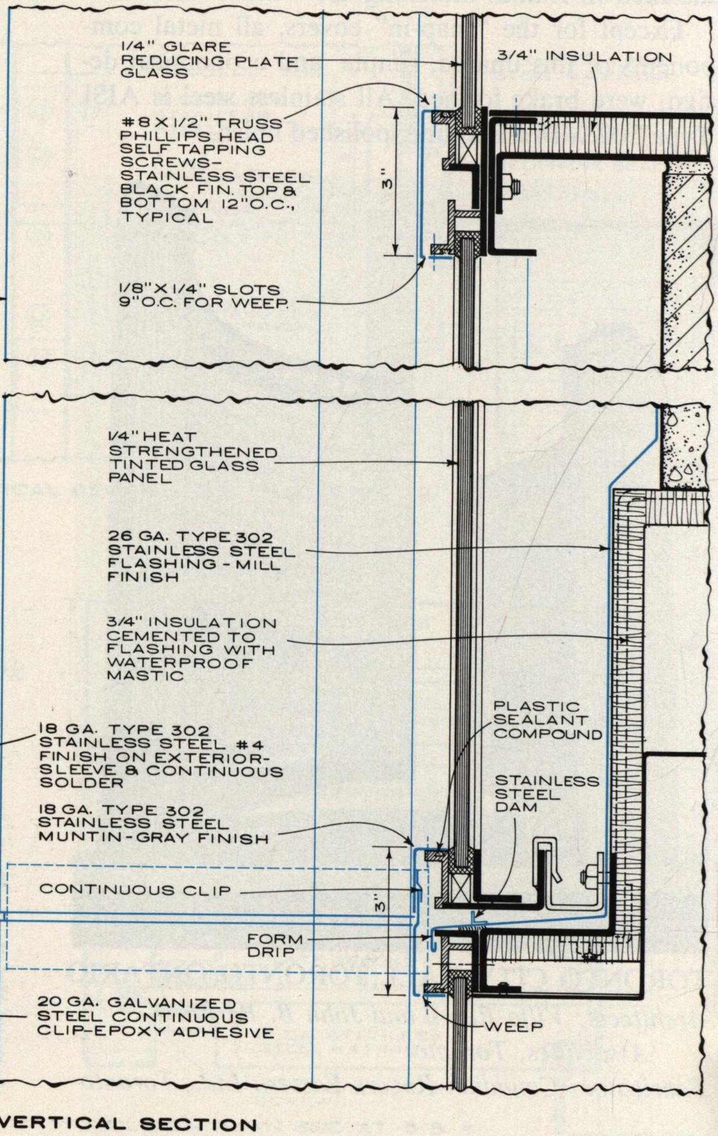
Architects: Harrison & Abramovitz, New York
Fabricator: Limbach Company, Pittsburgh, Pa.



Shop assembled carbon steel grid framing units form the basis of this 22-story curtain wall. One-piece, 16-gauge, brake formed, Type 302 stainless steel mullions with No. 4 finish are fastened to the vertical framing members with stainless steel screws. Extruded aluminum glass stops are sheathed with 18-gauge stainless steel, giving the wall an all stainless steel and glass exterior. The mullions act as bellows to compensate for horizontal thermal movement. Horizontal stainless steel members are colored "muntin gray" to blend with the tinted glass windows and spandrel panels.

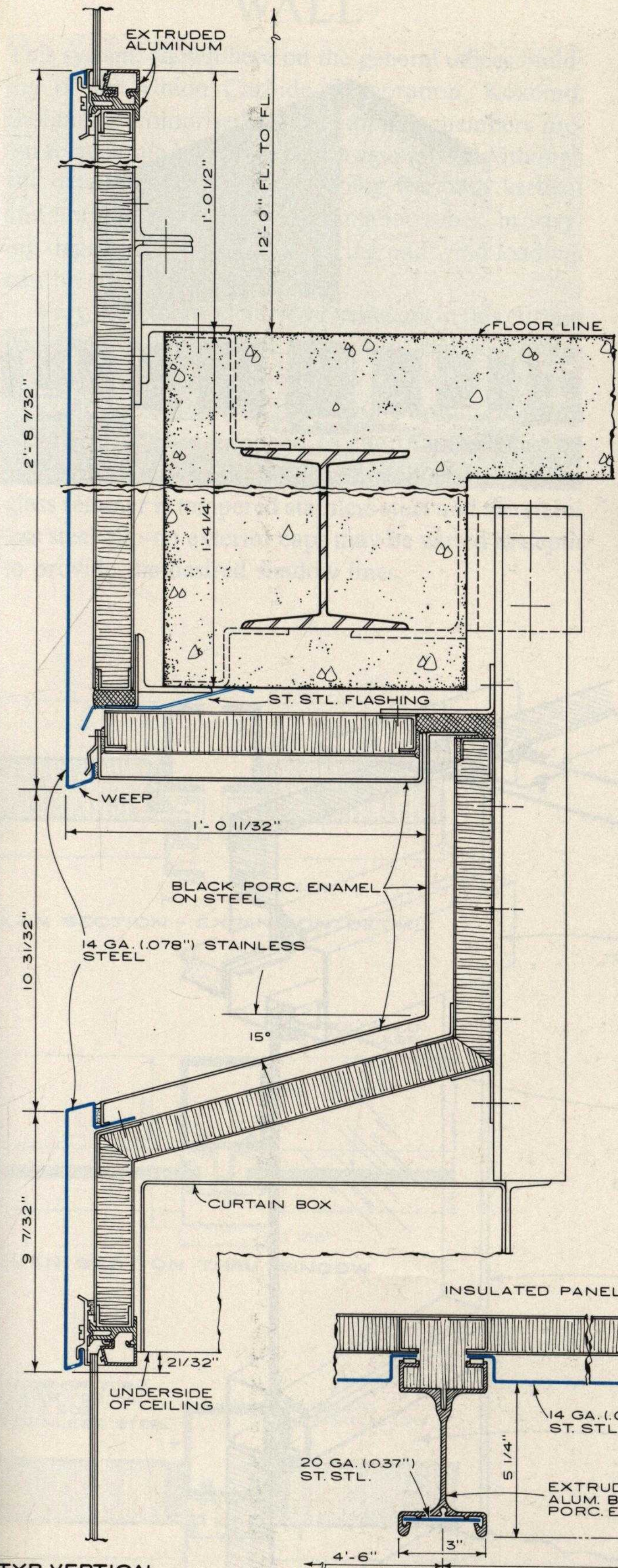


MULLION PLAN SECTIONS



VERTICAL SECTION

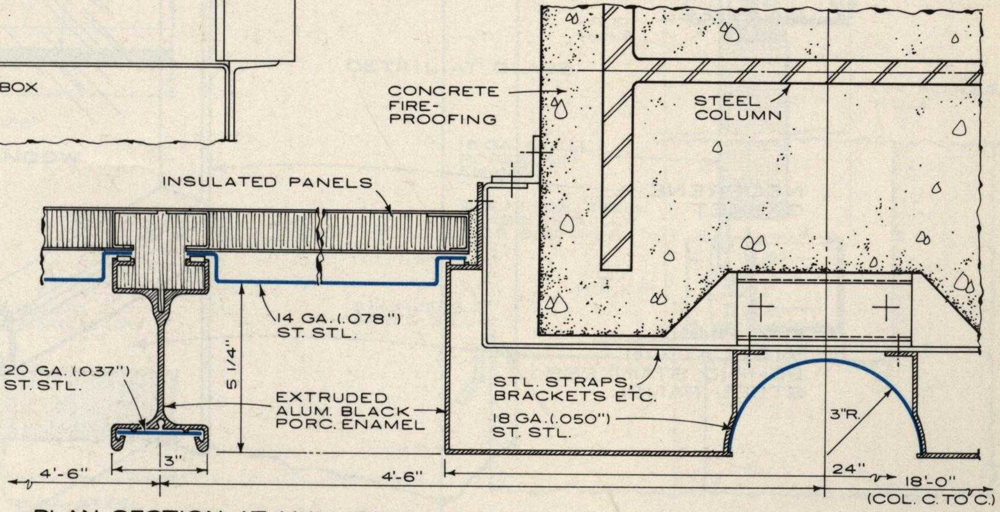
CUSTOM CURTAIN WALL



TYP VERTICAL SECTION AT FLOOR SLAB

MONTREAL TRUST TOWER, TORONTO, ONT.
Architects: Page & Steele, Toronto
Fabricator: Robertson-Irwin Limited, Hamilton, Ont., subsidiary of H. H. Robertson Company, Pittsburgh, Pa.

Black porcelain enamel, glass and stainless steel are combined in this custom metal wall. Deep pockets in the stainless steel spandrel panels contribute to the appearance of this award-winning 17-story office building. Other unusual features are the details of the brake formed panels, the curved recesses on column covers and the stainless steel inserts in the mullion faces. All stainless steel is No. 4 finish. Gauges are shown on sectioned details. Ground floor details are shown on page 37.



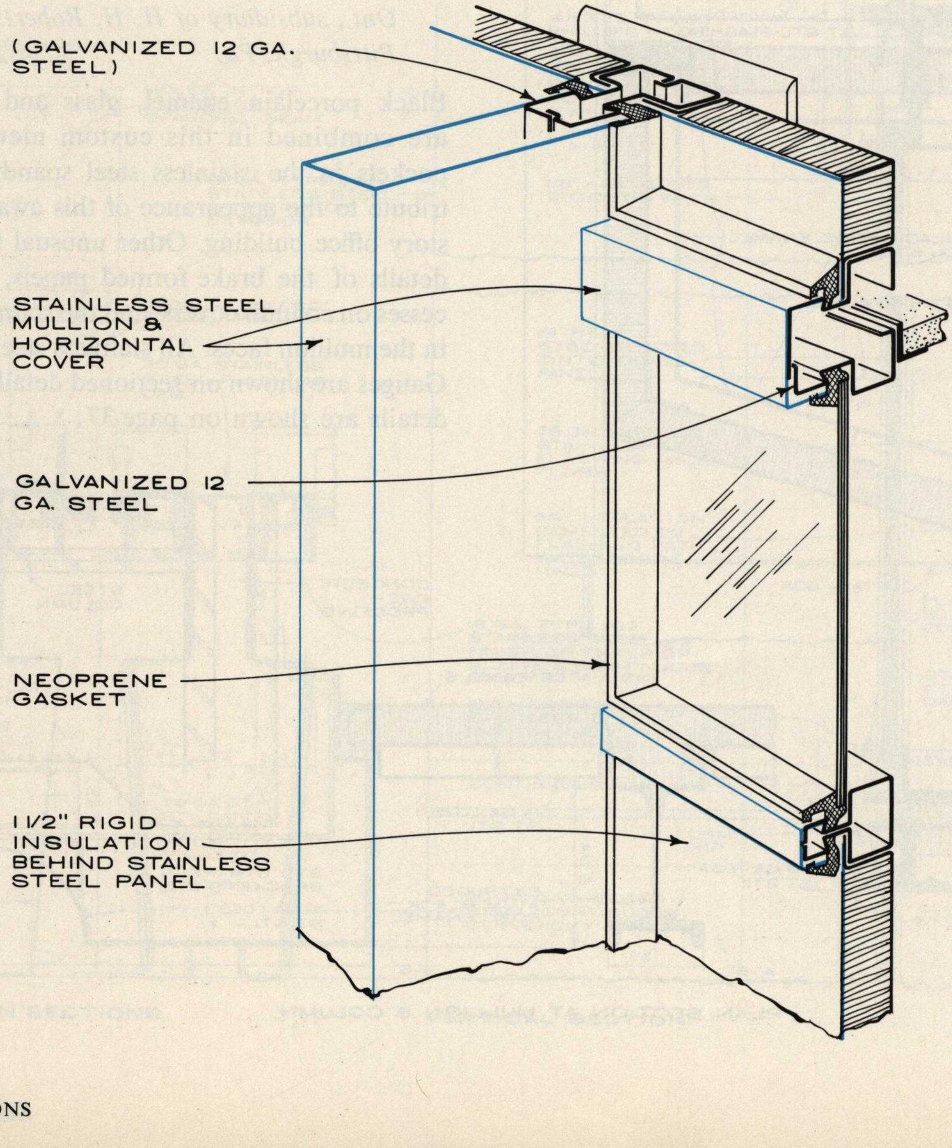
PLAN SECTION AT MULLION & COLUMN

PROPRIETARY CURTAIN WALL

ARLINGTON BANK AND TRUST, ARLINGTON, TEXAS

Architect: Preston M. Green, Fort Worth, Texas
Manufacturer: Fenestra Incorporated
The Fenclad System

This system employs 12-gauge galvanized welded grid units clad with 18- or 20-gauge, Type 302 stainless steel. Infill panels of porcelain enamel, stainless steel, or aggregate facings, as well as sash inserts and glazing, are retained by neoprene gaskets which also conceal mullion cladding fasteners. Split mullions facilitate erection and allow for thermal movement. Both load bearing and non-load bearing designs are possible, and horizontal spacing up to 8 feet can be accommodated.



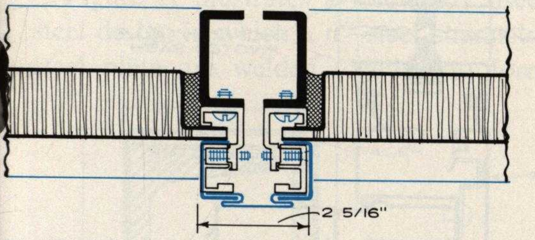
PROPRIETARY CURTAIN WALL

This system, shown here on the general offices building of the Union Carbide Corporation, Kokomo, Indiana, is comprised of steel tubular members precut to accurate lengths and field assembled. Although the details indicate square tubing for both vertical and horizontal members, rectangular tubes, in varying depths to suit mullion spacing and wind loading, can be supplied.

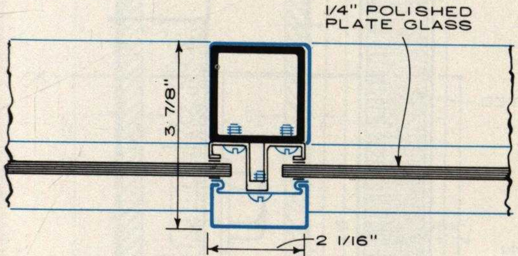
Very little thermal movement occurs in this curtain wall because the mass of the grid is inside the building, and heat loss is minimized by the small cross-sectional area of the glass and panel retaining members. Tubes exposed to the interior may be painted or may be covered with stainless steel. The glass retainer is tempered stainless steel and the stainless steel clip-on exterior caps may be varied in depth to provide the desired shadow lines.

UNION CARBIDE CORPORATION, KOKOMO, INDIANA

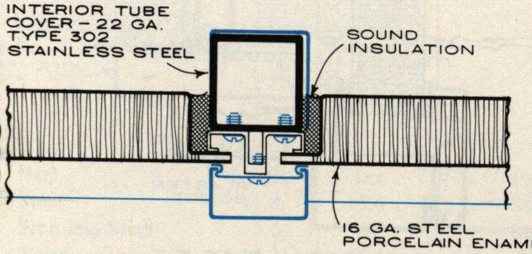
Architects: Fellheimer & Wagner, New York
Manufacturer: PPG Industries, Pittco Architectural Metals 82-X Framing System



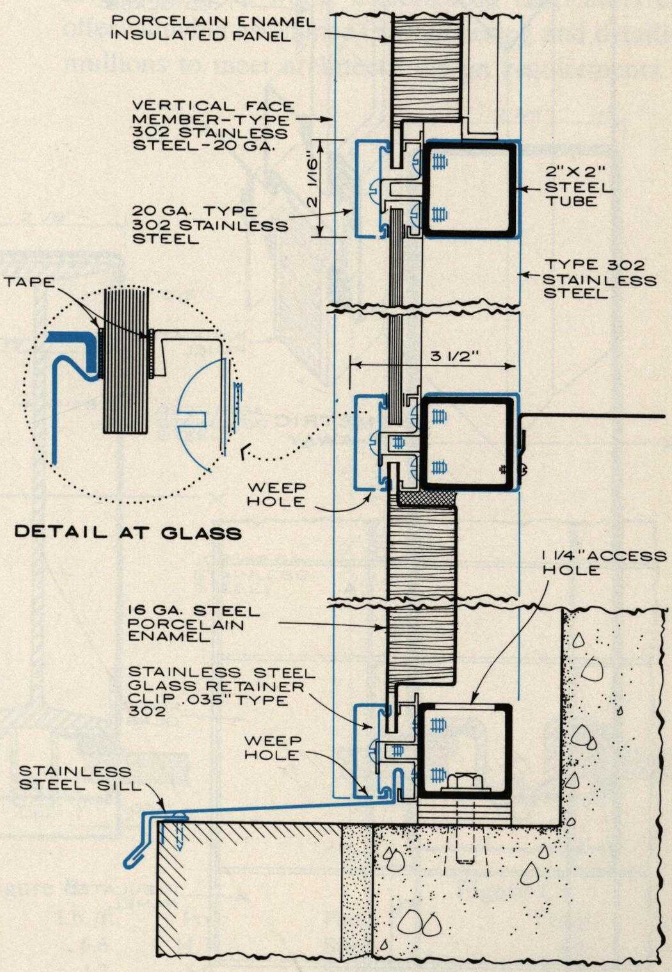
PLAN SECTION – EXPANSION DETAIL



PLAN SECTION THRU WINDOW



PLAN SECTION THRU PANEL



VERTICAL SECTIONS

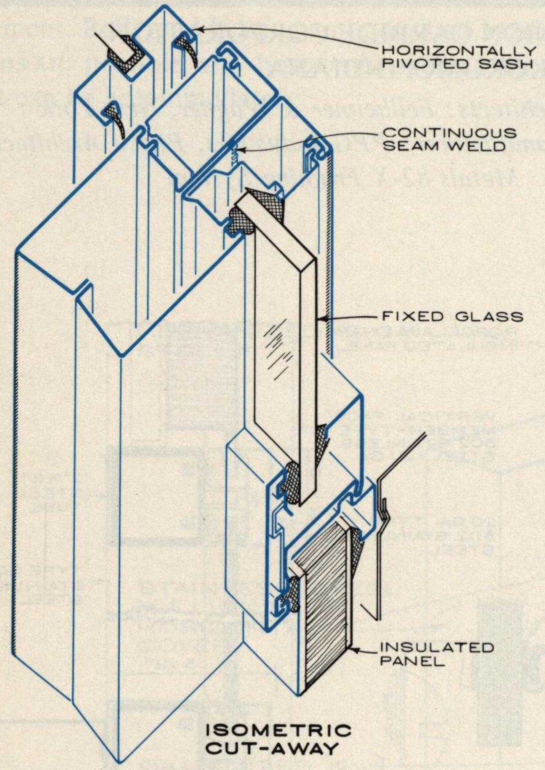
PROPRIETARY CURTAIN WALL

Manufacturer: United States Steel Corporation
USS Ultimet System

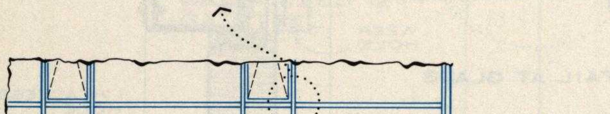
Vertical mullions are available in 3½″, 4½″ and 5½″ depths, depending upon structural requirements of the curtain wall. Each mullion is composed of two roll formed half mullion sections of .045″ thick, Type 304 (or 316) stainless steel welded together with a continuous seam weld. The ends of horizontal framing members are anchored on the sides of vertical mullions and joined with spring grip retaining clips fastened to the mullion webs.

Various adapter sections, which fit into mullions and horizontal members, are designed to receive glass, sandwich panels, horizontally pivoted windows and/or doors. All are retained within the framing grid by neoprene gaskets and can be installed from either inside or outside of the building.

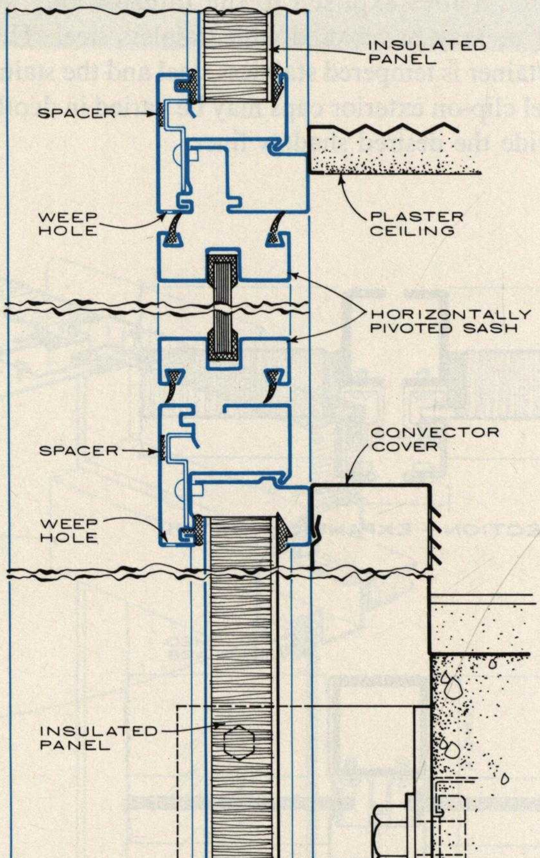
The system is designed for thermal movement in all directions with a built-in provision for drainage control.



ISOMETRIC CUT-AWAY



PARTIAL ELEVATION



VERTICAL SECTION DETAILS AT F·F

MULLIONS (Ground Floor)

Stainless steel ground floor mullions for office buildings and stores are usually tall (12 to 15 feet) and widely spaced (5 to 12 feet) to accommodate large glass areas. These mullions must be designed to resist wind loads on the glazed areas of 15 to 50 p.s.i., according to locality. To achieve slender reveals and provide maximum vision, the designer usually attempts to minimize the dimensions of the mullion cross section. Deflection considerations control structural design, and mullion sections of considerable depth are required to provide adequate stiffness.

There are three basic approaches to the design of stainless steel mullions: The mullion may have a thin, nonstructural veneer of stainless steel over a structural steel core formed from hot rolled or built-up shapes; the stainless steel cladding may be structural and work in conjunction with a carbon steel inner structure; or, the exposed stainless steel section may be designed with sufficient thickness and size to meet structural requirements without the need for internal reinforcing.

Figure A illustrates a frequently used structural steel design in which a 6″ steel channel and a $\frac{3}{16}$″ steel plate are welded together to form a strong rectangular tube. The stainless steel cladding and snap-on cover are .038″ thick and are not considered structurally. An advantage of designs of this type is that the structural steel may be erected first and the stainless cladding added later when exposure to possible damage is reduced.

An alternative is shown in Figure B, in which a 6″ junior I-beam, two .075″ formed steel shapes and an .062″ stainless steel casing are welded together to form a structural unit. Designs of this type can be very efficient structurally and offer ease of fabrication. Figure C illustrates a brake formed .109″ stainless steel mullion with no structural core. Slightly greater overall dimensions have been used, but a considerable saving in weight and simplified fabrication compensate for the increased use of stainless steel.

If extreme slenderness is desired, a structural steel core is usually necessary to provide an adequate moment of inertia economically. On the other hand, the use of heavier gauge stainless steel (.062″ and thicker) minimizes visual flatness problems during fabrication and erection. Heavier gauges also provide greater resistance to indentation, a distinct advantage in ground level work. Experienced fabricators can offer valuable assistance in engineering and detailing mullions to meet architects' design requirements.

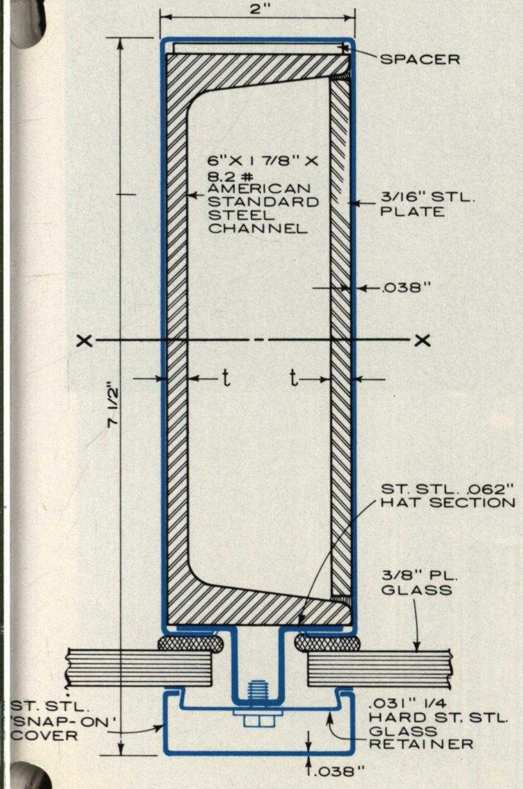


Figure A

Part	Lb./ft.	Ixx
Steel	11.8	15.6
Stainless Steel	3.5	—
Total	15.3	15.6

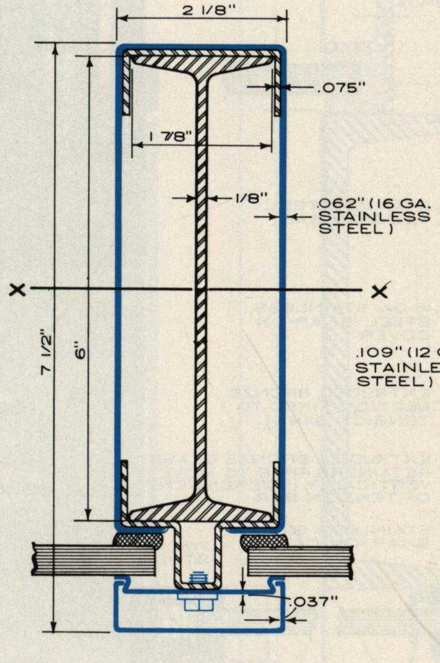


Figure B

Part	Lb./ft.	Ixx
Steel (total)	6.6	11.3
Stainless Steel	4.3	5.0
Total	10.9	16.3

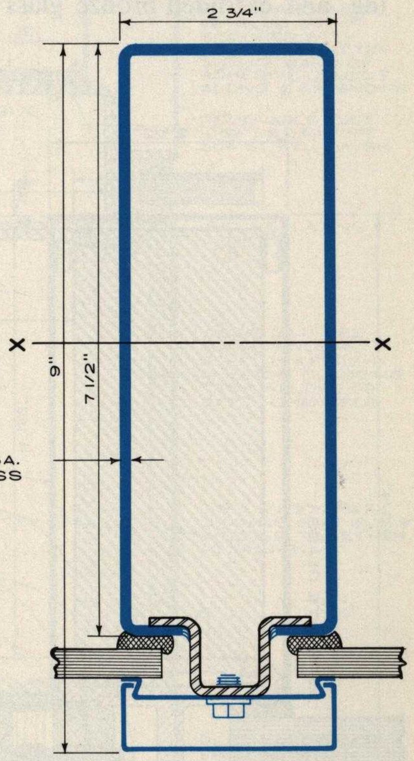


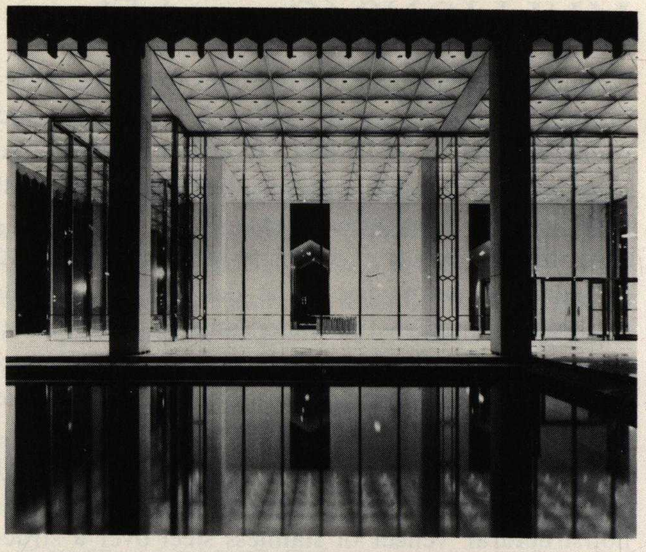
Figure C

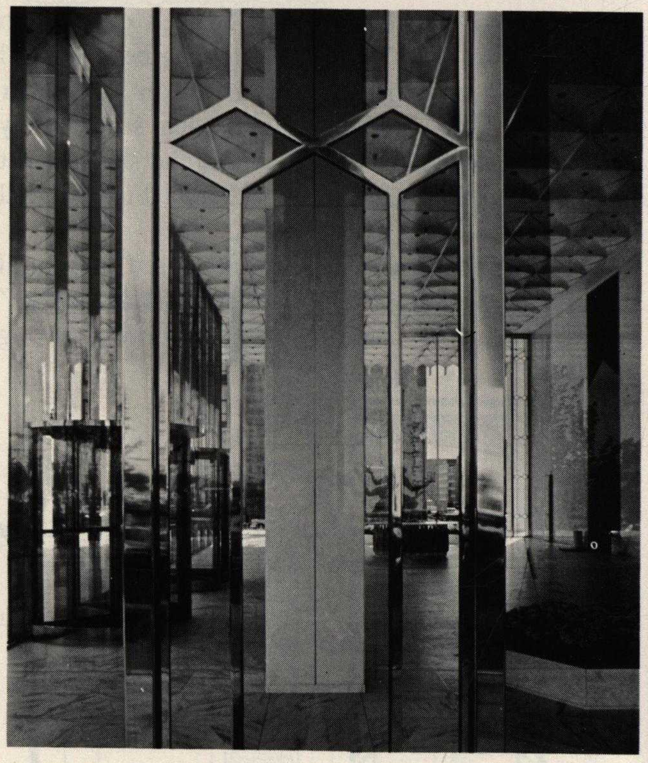
Part	Lb./ft.	Ixx
Steel	1.3	—
Stainless Steel	8.2	—
Total	9.5	16.5

MULLIONS (Ground Floor)

MICHIGAN CONSOLIDATED GAS BUILDING, DETROIT

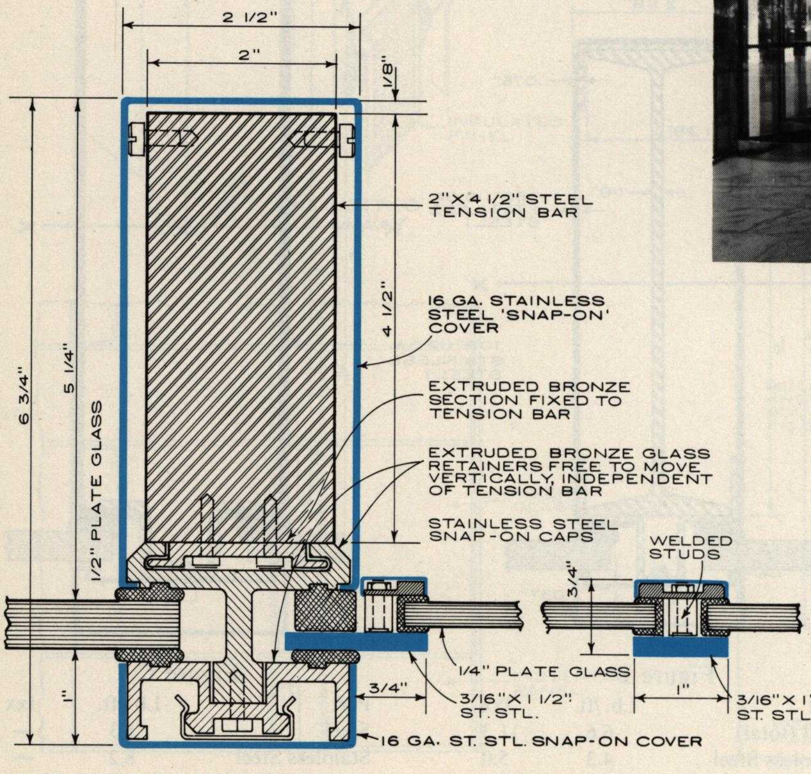
*Architects: Minoru Yamasaki, Birmingham, Mich.
Smith, Hinchman & Grylls Associates, Inc., Detroit, Mich.*
Fabricator: Moynahan Bronze Company, Flat Rock, Mich.





The remarkable slenderness of these 25-foot tall mullions is made possible by placing their internal structural member, a rectangular steel bar, under tension to achieve the required stiffness. The highly reflective finish (AISI No. 7) of the stainless steel encasement enhances their slim appearance. Nominal spacing of mullions is 4′-8″, except at column centers where they are 2′-4″ apart.

The 2″ by 4½″ solid steel tension bar is fixed at the head and pulled downward with a load of 2000 pounds by an adjustable coil spring installed below the floor. This tensioning gives sufficient rigidity to the mullion to resist horizontal wind loading and to maintain deflection within design limitations. Another unique feature is the provision made for independent thermal movement of tension bar, stainless steel casing and extruded bronze glass retaining members.



SECTION THRU MULLION & GRILLE

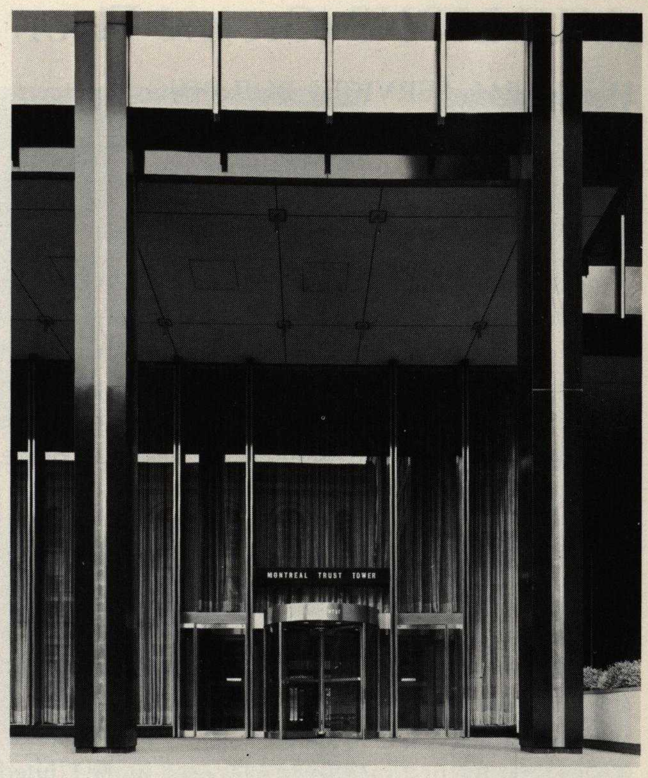
MULLIONS (Ground Floor)

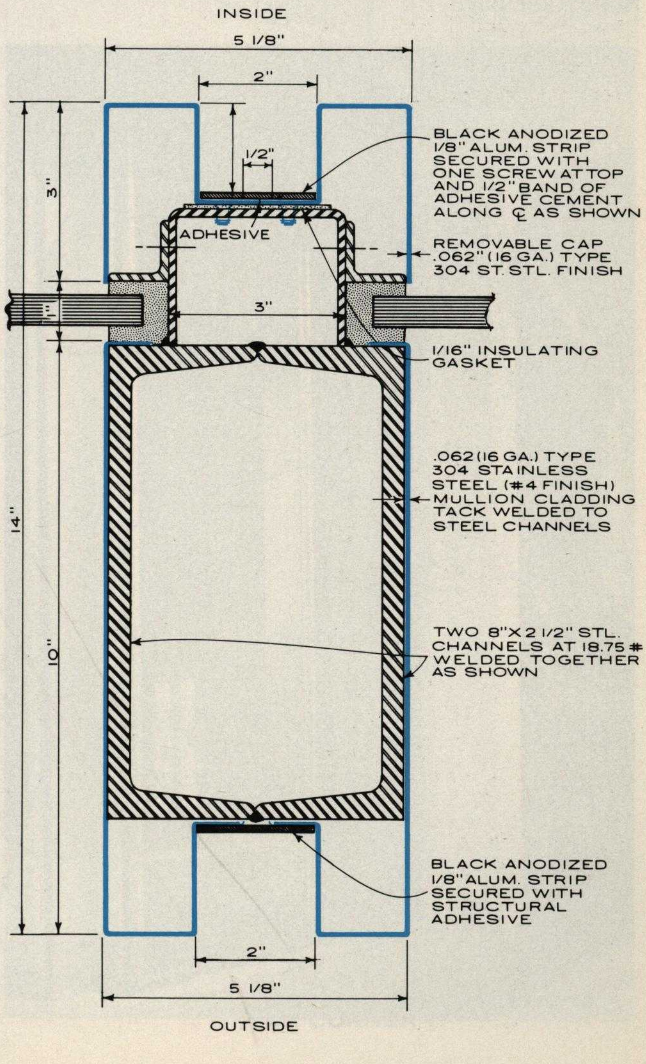
**MONTREAL TRUST TOWER,
TORONTO, ONTARIO**

Architects: Page & Steele, Toronto, Ont.
Fabricator: Cunningham & Lea, Scarborough, Ont.

Illustrated is an entrance and a few of the fifty very tall ground floor mullions of this stainless steel-clad building. Mullions are approximately 24 feet long with an overall cross section of 5⅛″ by 14″ (see detail).

The 16-gauge stainless steel cladding members and caps were each brake formed in one continuous length from "tension leveled" strip; consequently, no horizontal joints were necessary. Curtain Wall details are shown on page 31.





DIVISION 8

MULLIONS (Ground Floor)

MUNICIPAL SERVICES BUILDING, PHILADELPHIA

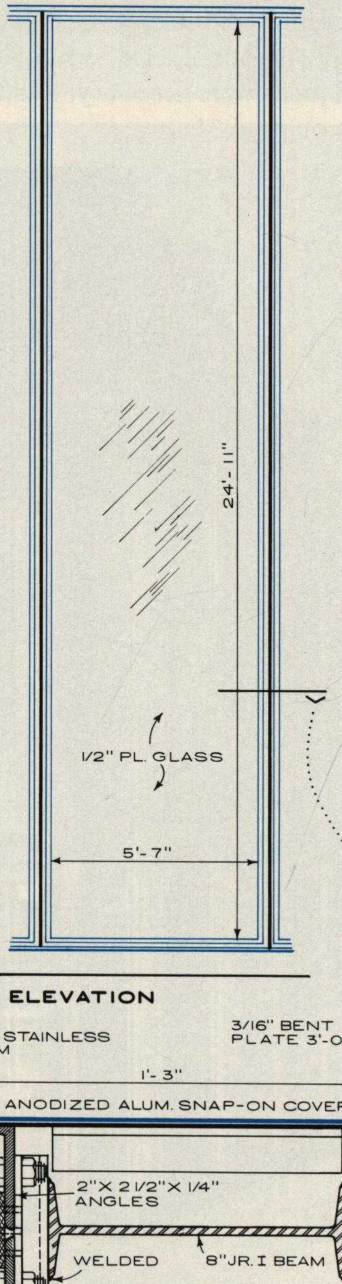
Architects: Vincent Kling & Associates, Philadelphia, Pa.

Fabricator: Habgood Company, Philadelphia, Pa.

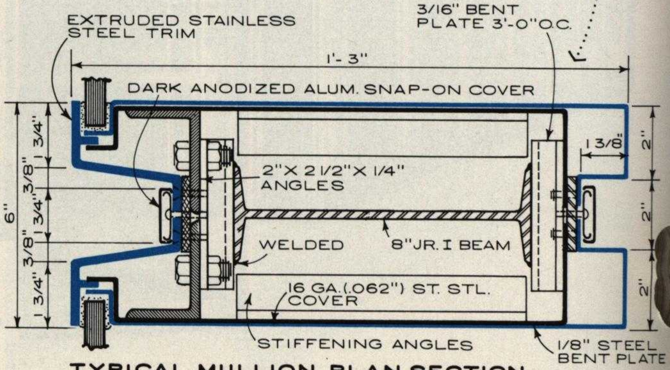
A novel feature of these 25-foot high mullions is the extruded stainless steel section used as a glass retainer or trim member on the exterior. The structural element is a combination of 1/8″ bent steel plate, an 8″ junior I-beam and two angles, all encased in 16-gauge, Type 302, No. 4 finish stainless steel brake formed sheet.

Although the cross section measures 6″ by 15″, the appearance of slenderness is achieved by the 2″ recess in each 6″ face. Head and sill members have the same recess.

Also of interest are the tall stainless flagpoles on the plaza and the brake formed hexagonal stainless steel lightpoles installed by the City of Philadelphia. These were the first such lightpoles used in the United States (see page 72).



ELEVATION

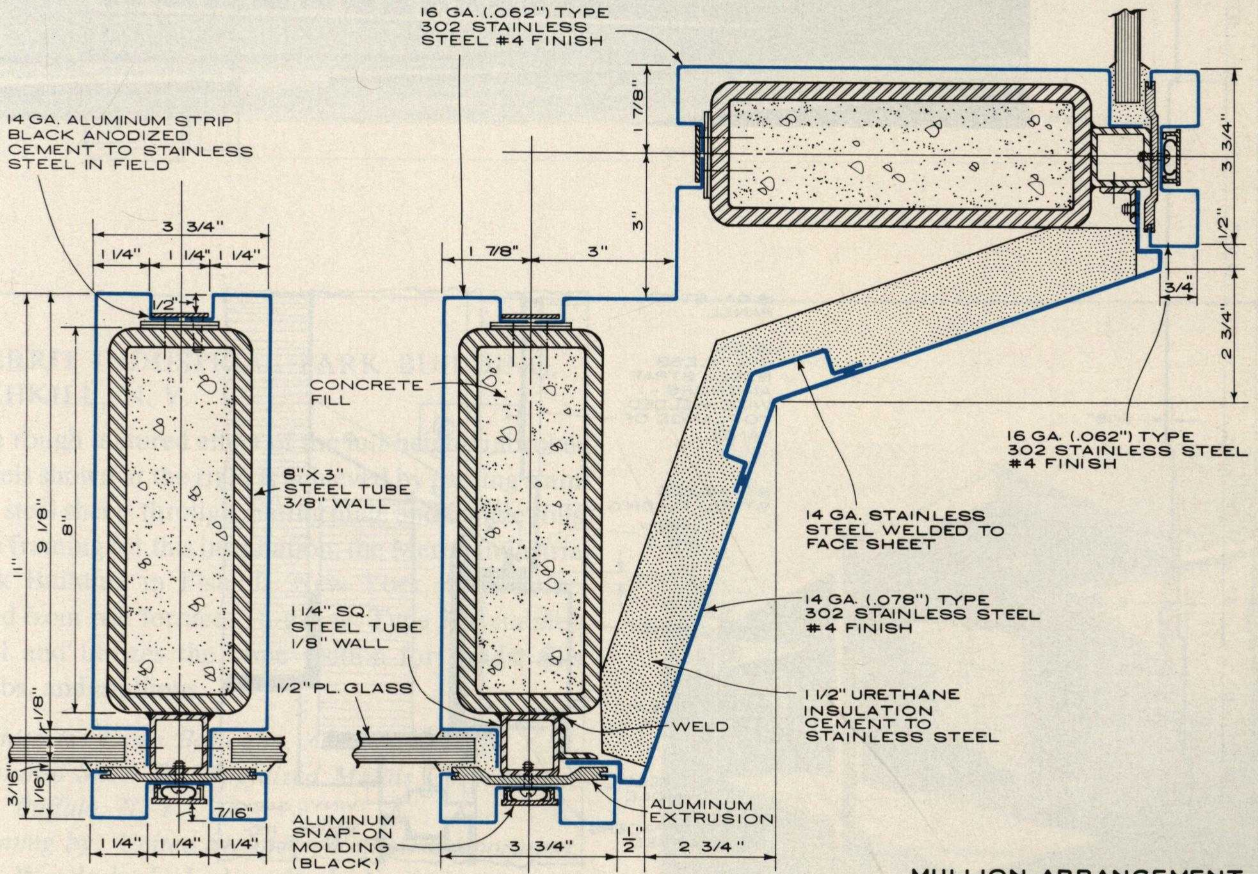


TYPICAL MULLION PLAN SECTION

MULLIONS (Ground Floor)

ILLINOIS BELL TELEPHONE COMPANY BUILDING, CHICAGO
Architects: Holabird & Root, Chicago
Fabricator: Flour City Architectural Metals, Minneapolis, Minn.

Mullions 17′-6″ high, spaced at 8-foot centers, support ½″ plate glass ground floor windows. The structural element is an 8″ by 3″ by ⅜″ wall steel tube filled with concrete and clad with stainless steel. Note the interesting corner mullion arrangement. The photograph also reveals many other items of stainless steel, including revolving doors by International Steel, Evansville, Indiana, as well as louvers, radiator grilles and interior railings.



SINGLE MULLION

MULLION ARRANGEMENT AT CORNER

PRESSED PANELS

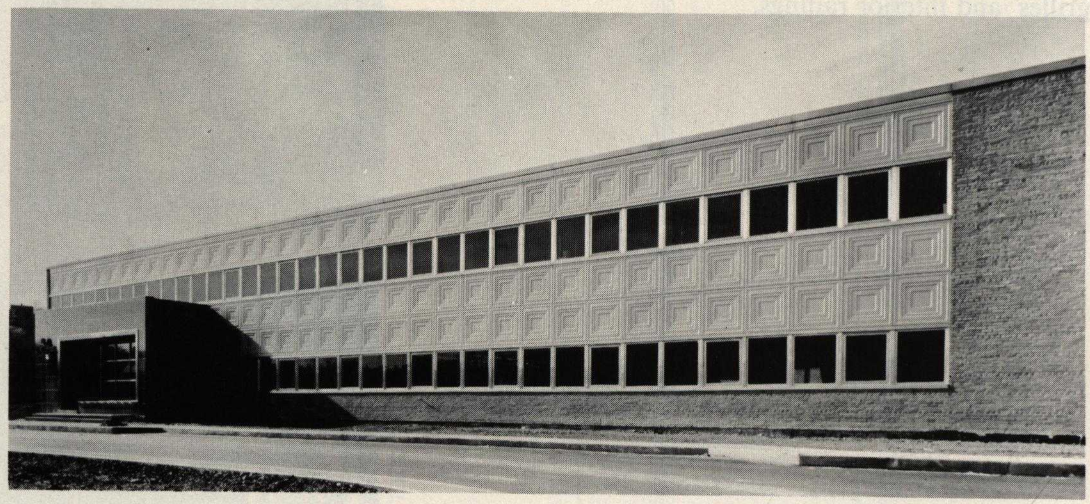
ALLEGHENY LUDLUM STEEL CORPORATION, LEECHBURG, PA.

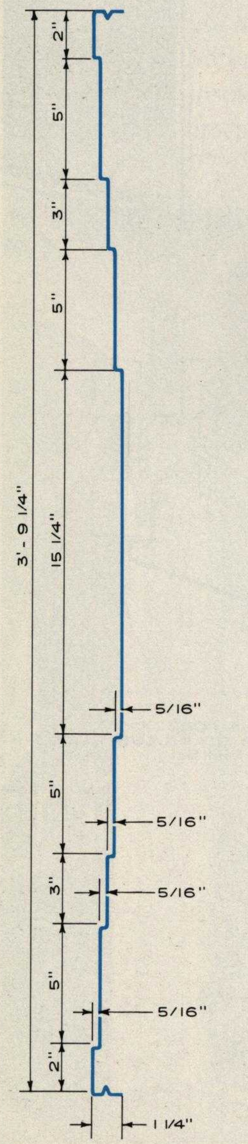
Architects: W. B. Simboli & Associates, Pittsburgh, Pa.
Fabricator: Trio Industries, Bridgeport, Conn.

Stainless steel panels are produced by press forming, brake forming and by laminating plain or patterned sheets to other materials. The examples shown in this section are for exterior wall applications, although the same technique can apply to panels for interior uses, such as elevator cab linings, partitions, decorative screens and so forth.

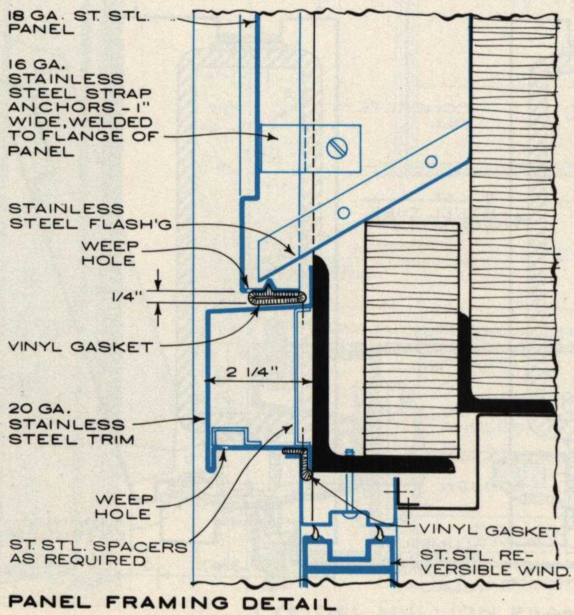
Except for industrial and commercial buildings, for which standard brake formed or roll formed interlocking sections are available, panels are custom formed for each project. Special tooling is an important consideration confronting the designer in press formed panels. The expense of special tooling, however, can often be justified when large quantities of an item are contemplated.

The concentric square panels for this office building were formed from 20-gauge (.038″) stainless steel with the owner's proprietary matte finish in a 750-ton hydraulic press using inexpensive dies.





VERTICAL SECTION THRU PANEL

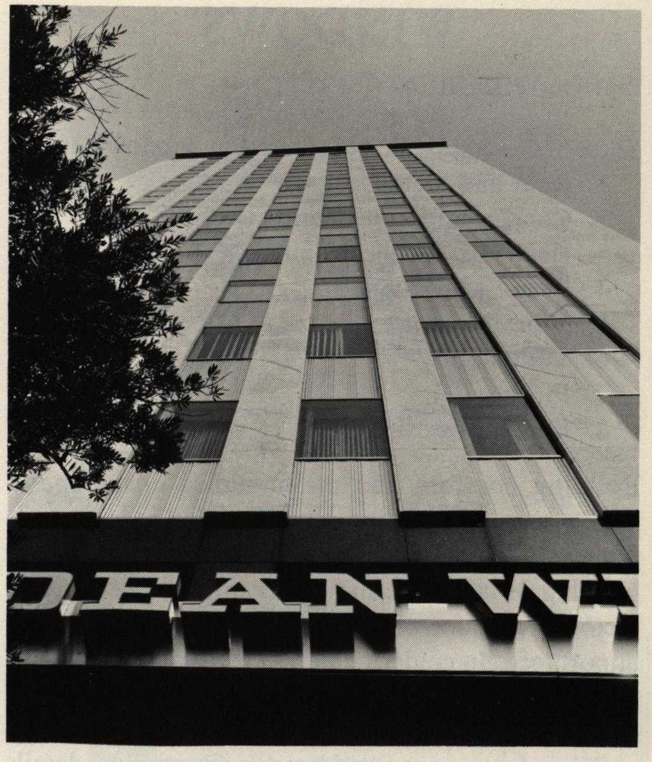


PANEL FRAMING DETAIL

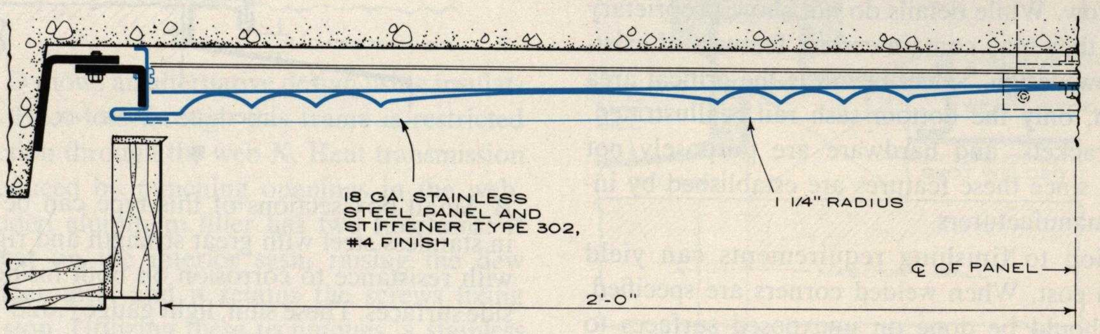
PANELS

KIRKEBY CENTER, WESTWOOD VILLAGE, CALIFORNIA

Architects: Claude Beelman and Kent Attridge, Los Angeles
Fabricator: Construction Metalwork Corporation Los Angeles

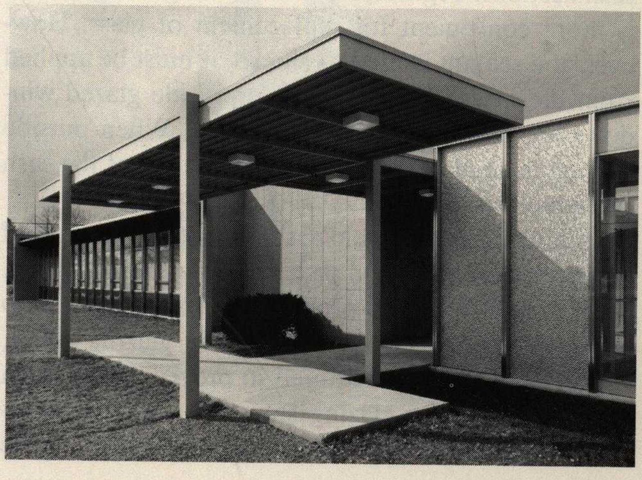


In this attractive design, spandrel panels are brake formed to achieve a dominant vertical ribbed effect. This not only enhances the design theme but contributes to rigidity and avoids optical distortion in the light 18-gauge No. 4 polished sheet. A corollary advantage is the absence of horizontal surfaces facilitating self-cleaning.



MERRIT INDUSTRIAL PARK BUILDING, FISHKILL, N. Y.

The rough textured effect of the full-height unbroken panels shown at the right is achieved by passing stainless steel sheets through mating male and female rolls. The framing for this installation, the Merrit Industrial Park Building in Fishkill, New York, is manufactured from roll formed, 18-gauge, Type 304 stainless steel and utilizes the same section for heads, sills, jambs, and mullions.



Architects: Louis Battoglia, AIA, Fishkill, N. Y.
Textured Sheet By: Rigidized Metals Corporation, Buffalo, N. Y.
Framing by: United Stainless Window Corporation, Woodside, L. I., New York, N. Y.

WINDOWS

WINDOW DESIGN

These factors must be considered in window design:
1. Rain and water leakage
2. Condensation on interior surfaces
3. Heat loss and heat gain
4. Sound transmission
5. Vibration noise
6. Ventilation
7. Finish
8. Ease of operation

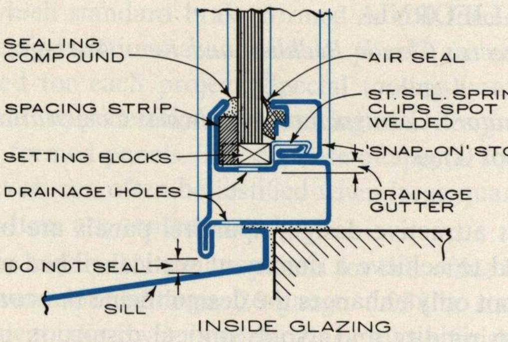
Building comfort and maintenance cost depend largely upon the quality of window design, construction, and installation. Geographical location of the building usually determines the importance of each factor. Prevention of water leakage is always of prime importance. In colder climates air leakage, heat loss and condensation are equally important. For certain occupancies, sound transmission can be a vital factor.

These factors are considered in the window details which follow. While details do not show proprietary products, they may contain certain features of existing window design. Since the sill is the critical area for design, only the bottom sash rail is illustrated. Joints, brackets and hardware are purposely not indicated, since these features are established by individual manufacturers.

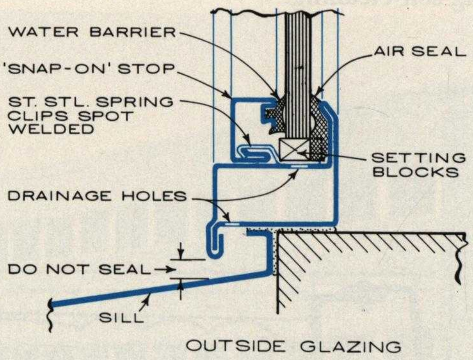
Attention to finishing requirements can yield savings in cost. When welded corners are specified, welding should be done on unexposed surfaces to avoid grinding and refinishing. If exposed welds are unavoidable, a neatly applied welding bead may be acceptable without grinding, particularly if the windows cannot be observed from close range.

Figures A and B compare the merits and disadvantages of inside and outside glazing for similar fixed sash sections. Figure A shows inside glazing, which is more convenient for replacement of glass. However, if a sealant is used as shown, it must be applied from the exterior. Wind loads on inside glazed windows are imparted to the glass stop. When outside glazing is employed, Figure B, the flange of the sash receives the wind loads.

Window design should assume that penetration of water between glass and sash will occur at some time. Weep holes should be provided to conduct water to the exterior. Note that on the inside glazing detail, Figure A, a gutter is required to prevent water from running under the glazing stop and into the building. This is not required for outside glazing, Figure

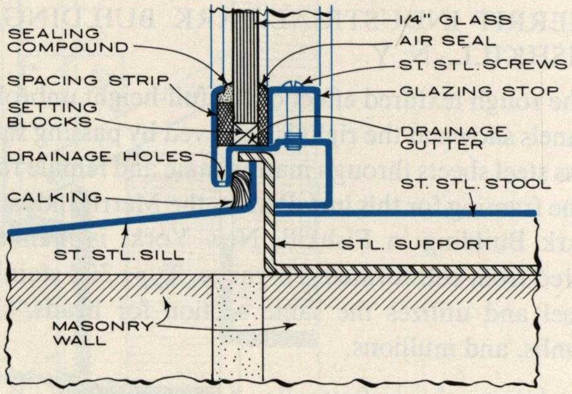


A



B

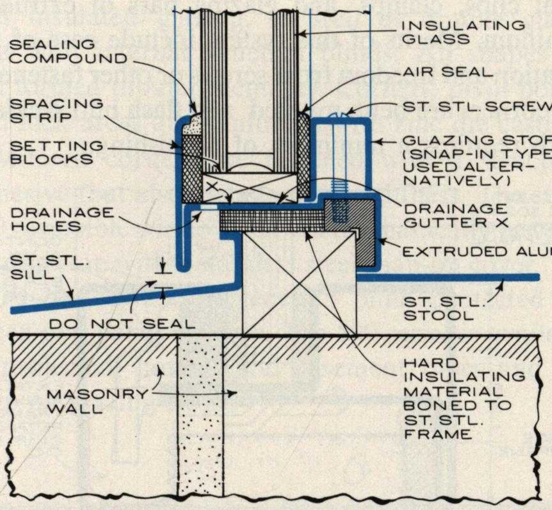
B. Small box sections of this type can be produced in stainless steel with great strength and rigidity and with resistance to corrosion on both inside and outside surfaces. These slim, light gauge (.020″ to .030″) sections conduct much less heat from interior to exterior than windows of comparable strength made of other metals, and condensation on the interior is substantially reduced.



C

Figure C shows a sample fixed sash frame with single inside glazing. Because this is an "open" shape, the gauge should be heavier (.030″ to .050″) than

for a hollow or box section. The glazing stop may be fixed by screws, as shown, or by means of a "snap-on" stop, as in Figure A. Drainage holes in the outside lip conduct possible water leakage to the exterior.

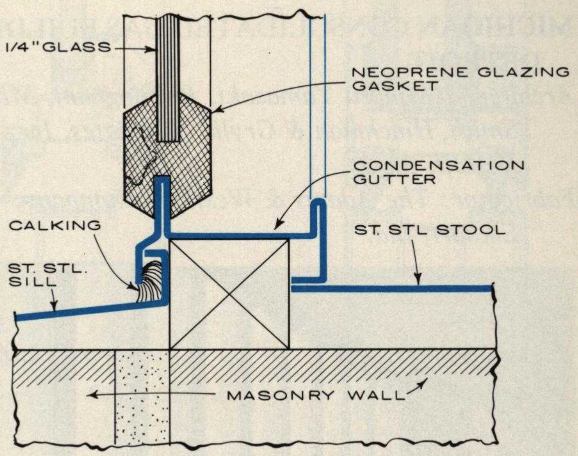


D

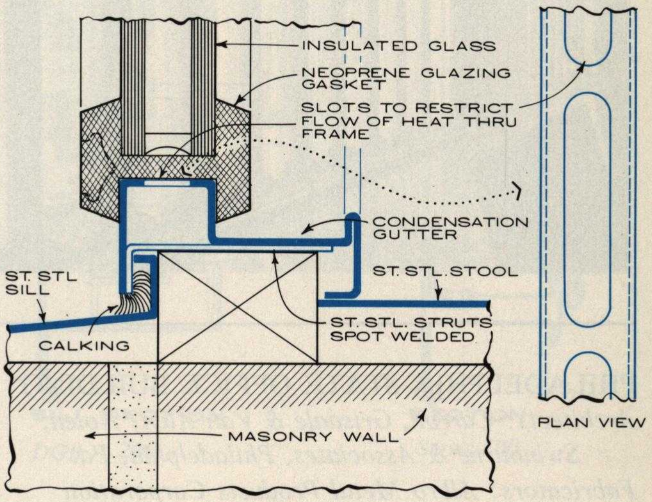
Figure D shows an alternative design using insulating glass. Heat loss through this frame is restricted to conduction through the web X. Heat transmission can be reduced by punching openings in the web. The extruded aluminum filler has two functions: it retains heat on the interior sash, raising the dew point temperature, and it retains the screws fixing the glass stop. Utilizing these techniques, a stainless steel sash without a positive thermal break in metal can be designed to function satisfactorily in fairly high indoor relative humidity.

Figures E and F show sample roll formed sections designed for use with neoprene glazing gaskets. In both examples little metal area is exposed to the exterior, and condensation problems should be minimal. Figure F shows how metal can be removed from the web section within the gasket to reduce heat transmission. Since some condensation can be expected when indoor relative humidity is high and outdoor temperature is very low, a gutter is provided to retain collected condensation where it can evaporate or be wiped dry.

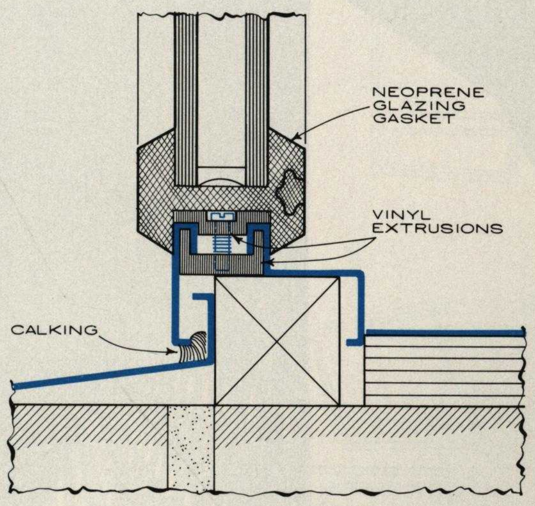
Figure G illustrates a two-part extruded vinyl thermal break which clamps together the inner and outer frame sections. This type of construction is required for very cold climates only.



E



F

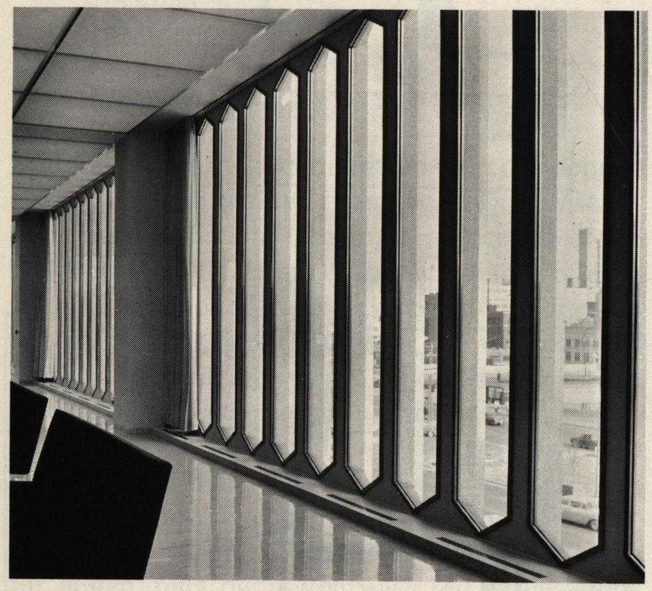


G

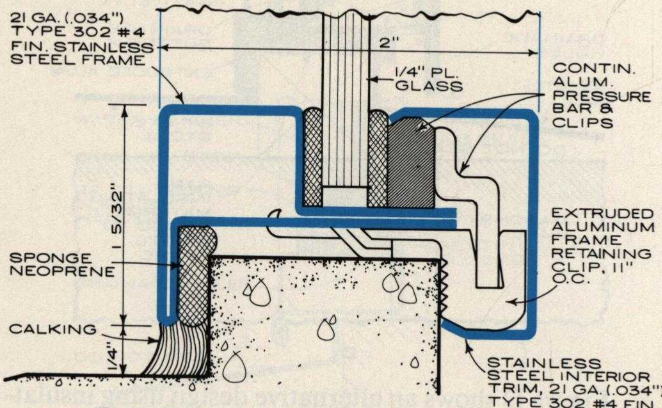
WINDOWS

MICHIGAN CONSOLIDATED GAS BUILDING, DETROIT

Architects: Minoru Yamasaki, Birmingham, Mich.
Smith, Hinchman & Grylls Associates, Inc., Detroit, Mich.
Fabricator: The Adams & Westlake Company, Elkhart, Ind.



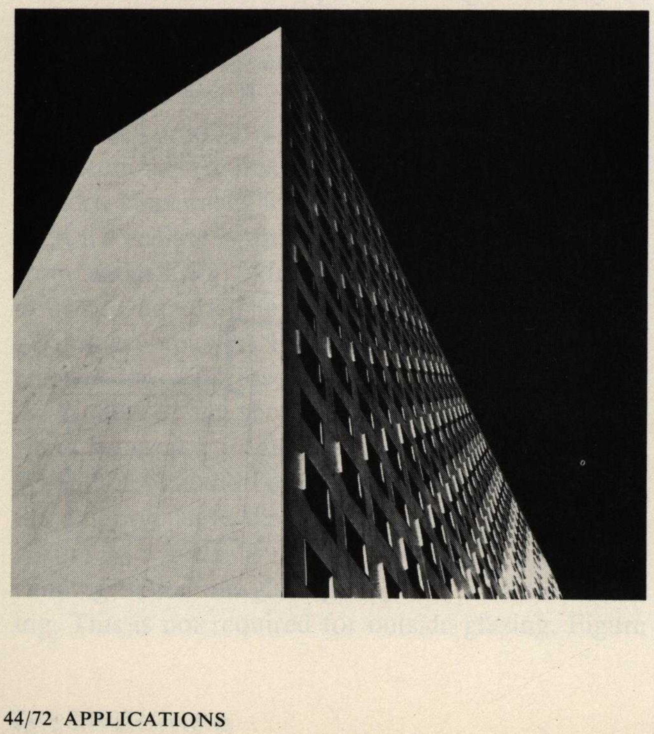
The need to provide a watertight fixed window in a precast concrete wall system and to achieve a narrow sight line prompted a successful collaboration of architect and fabricator. The result was an effective solution that combines a roll formed exterior frame and interior trim section of stainless steel with internal clips, clamps and glazing bars of extruded aluminum. Merits of this system include ease of installation and freedom from screws or other fasteners. The corners are bent, mitered and flash butt welded, which requires a minimum of refinishing.



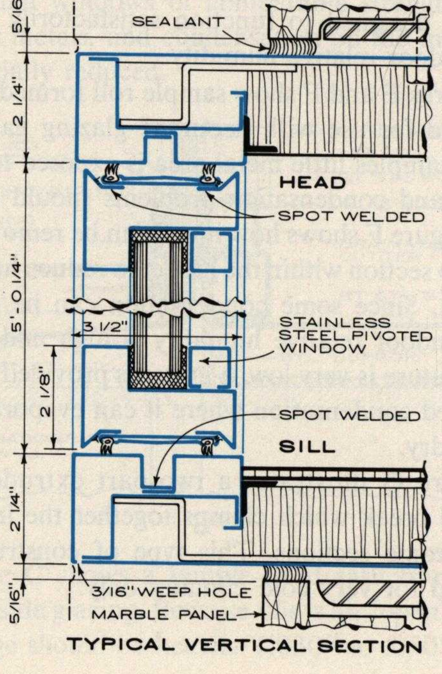
TYPICAL SASH DETAIL

PHILADELPHIA STATE OFFICE BUILDING

Architects: Carroll, Grisdale & Van Alen; Nolen, Swinburne & Associates, Philadelphia, Pa.
Fabricators: Albro Metal Products Corporation Philadelphia, Pa.



The marble facade of this monumental building is accented by the slight projection of alternate vertically pivoted windows. The frame and sash are composite tubular brake formed sections of 20-gauge, Type 302 stainless steel.



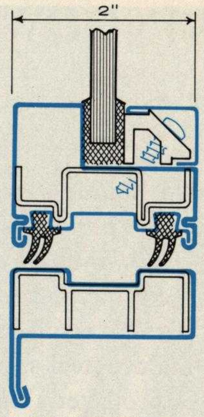
TYPICAL VERTICAL SECTION

PROPRIETARY WINDOWS

Manufacturer: United Stainless Window Corporation, Woodside, L. I., New York

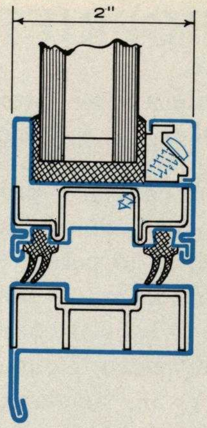
A specialist in standard stainless steel windows and curtain wall systems, United Stainless offers a vertically center-pivoted reversible window for both single and insulated glazing, as well as double glazed unit with internal venetian blinds. All shapes are roll formed tubular members. Corners, pivot points, and lock areas are reinforced with zinc die castings.

Mitered corners are fastened with a structural adhesive that also assures watertightness. The series 200 reversible windows have a mechanically fastened glazing stop with a stainless steel snap-on cover. The DGB-200 features a venetian blind protected between two panes of glass. The 500 series is available in projected, hopper and casement types and has snap-on glazing stops.



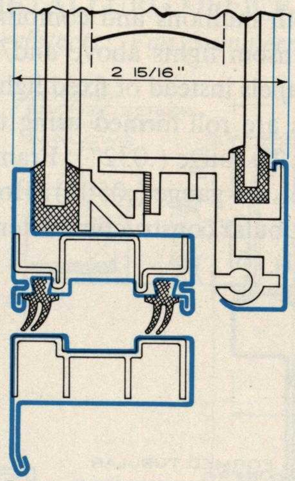
SILL SECTION

Series 200 Single Glazed



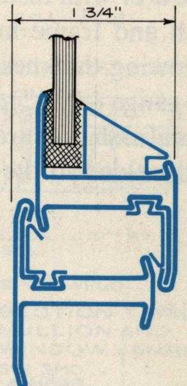
SILL SECTION

Series 200 Double Glazed



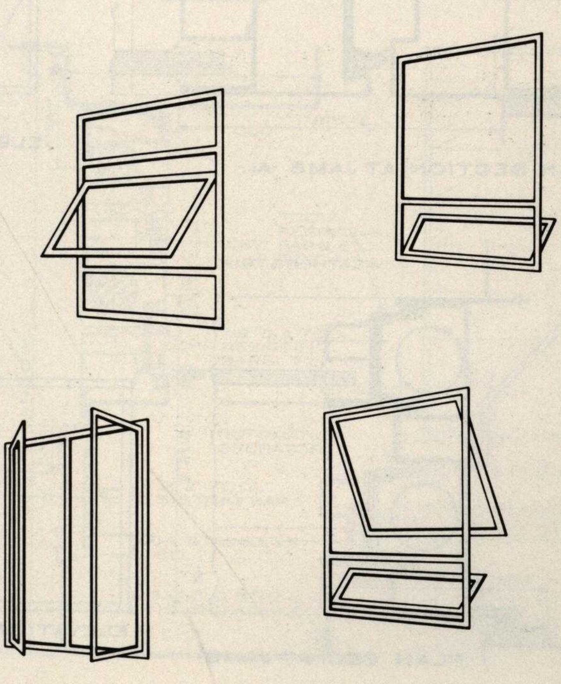
SILL SECTION

DGB — 200



SECTION

Series 500

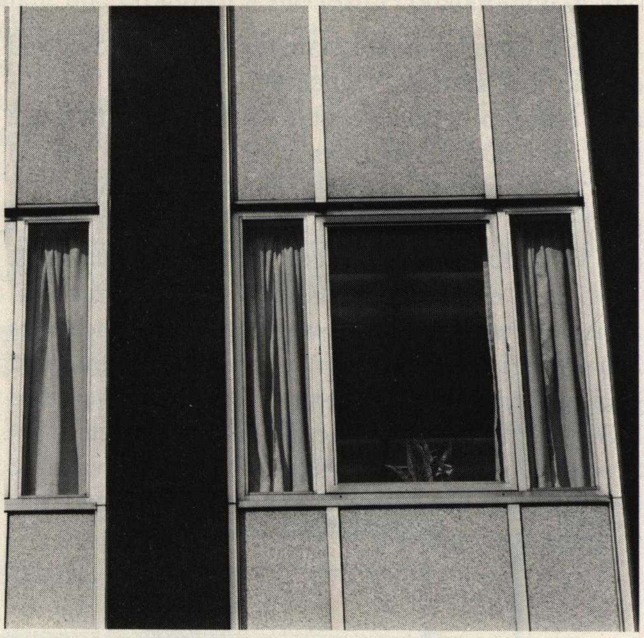


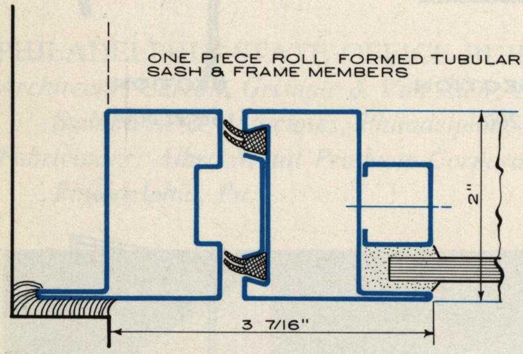
PROPRIETARY WINDOWS

Manufacturer: Trio Industries, Inc.,
Bridgeport, Connecticut

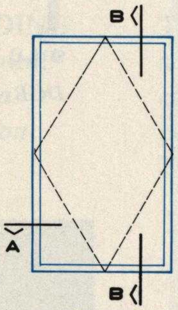
This company produces reversible stainless steel windows that may be vertically or horizontally pivoted to permit 360° rotation. The windows are available with a hopper ventilator. Frame and sash are of tubular construction with corners reinforced and welded. Double automatic stainless steel safety locks are standard. Stainless steel projected, casement, hopper and top-hinged ventilating windows are also produced by this manufacturer.

Trio double-hung stainless steel windows can be equipped with either overhead or spiral balances. They can be arranged with mullions and combined with fixed side lights, transom lights above and/or below or with insulated panels instead of fixed lights. Sash and frame members are roll formed using the following thickness: Sash, 22-gauge (.032″); Frame, 20-gauge (.038″); and Sill, 18-gauge (.050″). Horizontal sash rails are rigid tubular construction mitered and welded to the verticals.

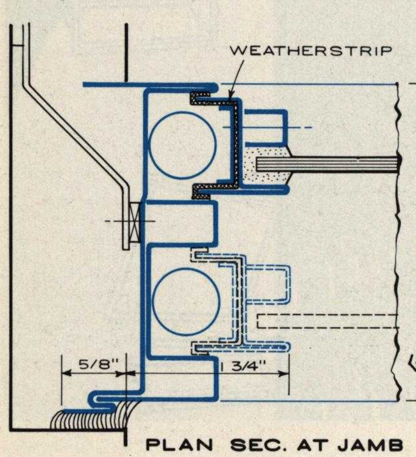




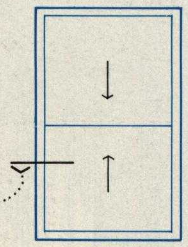
PLAN SECTION AT JAMB ·A·



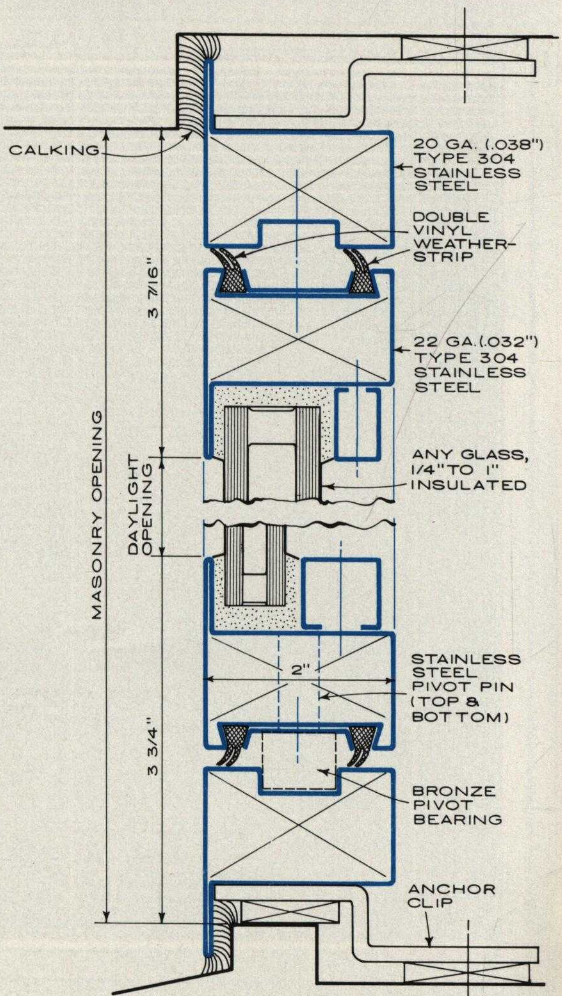
ELEVATION



PLAN SEC. AT JAMB



ELEVATION

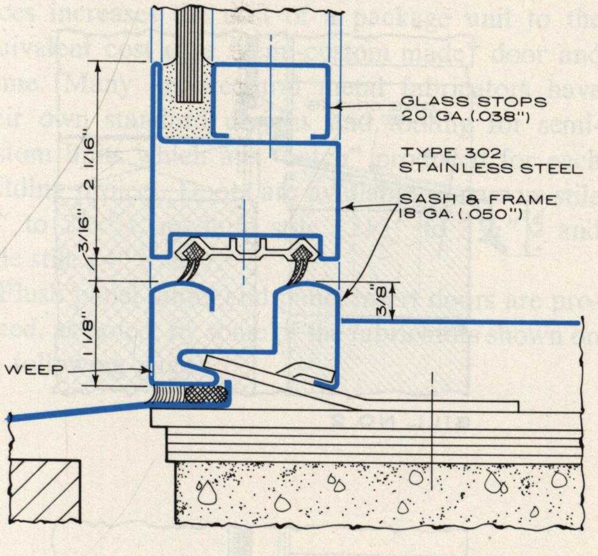


VERTICAL SECTION AT ·B·

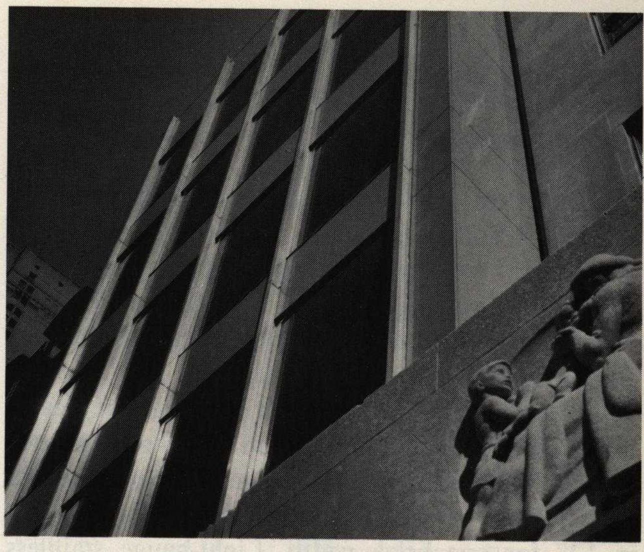
WINDOWS

Fabricator: General Bronze Architectural Products, Woodbury, L. I., New York
Vertically Pivoted Reversible Window, Series 9025

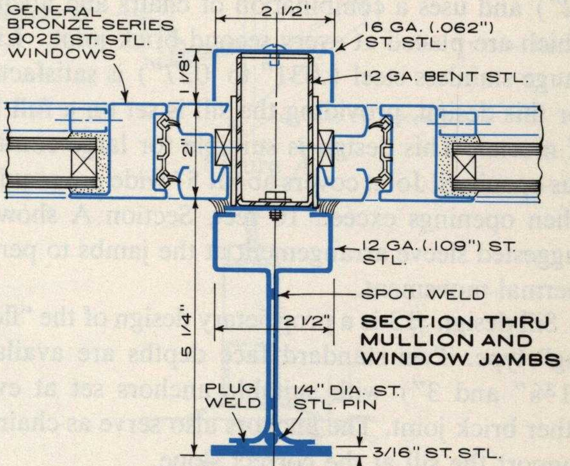
Stainless sash and frame are brake formed with mitered and welded corners. The vertically pivoted sash is sealed by a pair of double-finned vinyl weatherstrips, which are easily replaceable. Sash accommodates any glass up to 1″ thick, rotates 360°, locks automatically. The small office building at right utilizes the Series 9025 window with custom stainless mullions, copings and sills. Granite veneer panels complete the facade.



VERTICAL SECTION



METALLURG OFFICE BUILDING
Architects: Van Summern and Weigold, New York

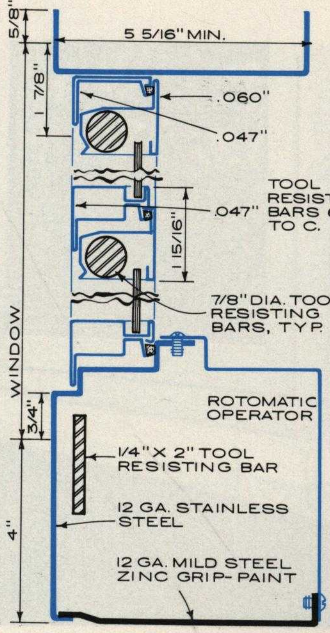


SECTION THRU MULLION AND WINDOW JAMBS

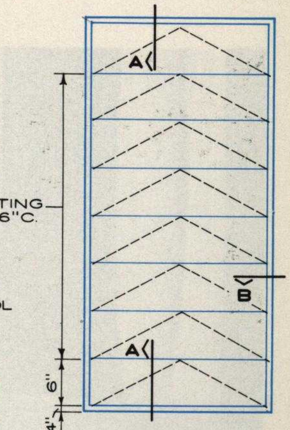
DETENTION WINDOWS

Manufacturer: The William Bayley Company, Springfield, Ohio

This maximum detention stainless steel window for correctional institutions was specified for the City of New York Adolescent Division addition on Riker's Island. Windows may be installed singly or joined by mullions in pairs or groups. Ventillating sash are linked together vertically. A concealed operating mechanism in the sill permits operation in unison. Operation can be remotely controlled or actuated by a removable crank or knob. In addition to the use of heavy gauge stainless steel, tool resisting steel bars (electro-galvanized) are built into the construction. The round steel bars act as pivots and prevent cutting with metal saws.



VERTICAL SEC. A-A



ELEVATION

ALL INTERIOR SCREWS APPROX. 12" O.C., EXTERIOR SCREWS APPROX. 9" O.C.

WINDOW SILLS

Manufacturer: Dawson Metal Company, Jamestown, New York

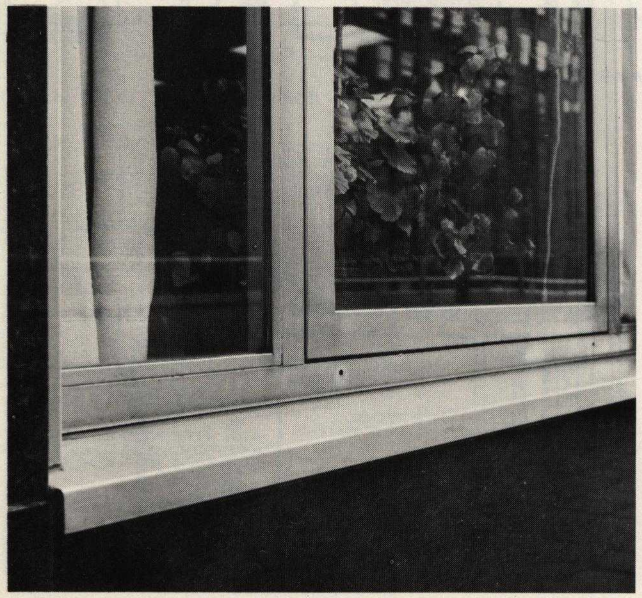
Stainless steel window sills are initially competitive with other materials and, in addition, offer definite advantages: no staining of adjoining masonry, durability and low maintenance cost. Sill sections are usually brake formed in 10-foot lengths. Three examples of sill design are presented.

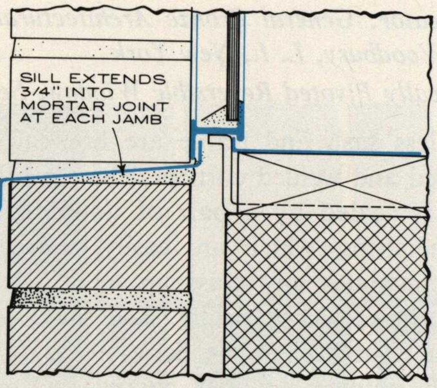
Sill design #1 is suggested for openings not greater than 6 feet. The sill should extend ¾″ into the mortar joint at the jambs and be set on a tapered bed of mortar. This provides a slope of approximately ¾″ in 12″ for one brick width. Light-gauge stainless (.031″ to .037″) is satisfactory.

Sill design #2 provides greater slope (1½″ in 12″) and uses a combination of chairs and anchors which are placed at every second brick joint. Light gauge stainless steel (.031″ to .037″) is satisfactory for this design, providing the sill is set on a full bed of mortar. This design is suitable for large continuous openings. Joint covers about 5″ wide are required when openings exceed 10 feet. Section A shows a suggested sleeve arrangement at the jambs to permit thermal movement.

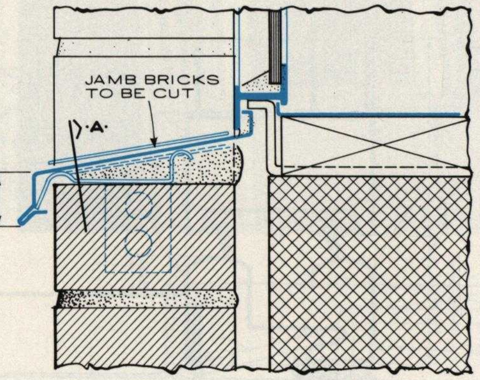
Sill design #3 is a proprietary design of the "floating" type. Two standard face depths are available (1⅜″ and 3″) with suitable anchors set at every other brick joint. The anchors also serve as chairs to support the sill at the correct slope.

Since these sills used 18-gauge (.050″) stainless steel, they did not require setting on a bed of mortar.

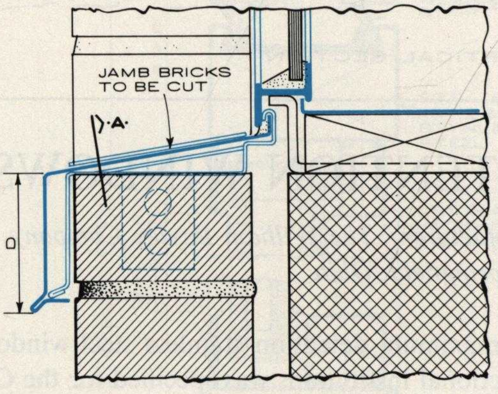




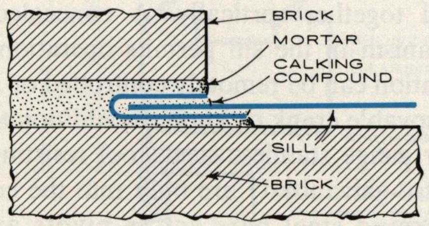
SILL NO. 1



SILL NO. 2



SILL NO. 3 TYPE A, D= 1 3/8"
TYPE B, D= 3"



JAMB SLEEVE SECTION AT A

DOORS

DOORS & ENTRANCE DETAILS

Examples (at bottom of page) show the types of doors most frequently specified in stainless steel. Narrow stile package units of entrance doors and frames are quantity produced by several companies. These units provide economy, accuracy, and proper clearances between door and frame. Figure A names the components of a standard entrance unit. Figure B shows the recommended clearance (5⁄8″) between bottom rail and floor, giving adequate clearance throughout the full area of the door swing and providing 1⁄8″ clearance above a 1⁄2″ threshold.

Departure from standard dimensions and clearances increases the cost of a package unit to the equivalent cost of a "semi-custom made" door and frame. Many architectural metal fabricators have their own standard designs and tooling for semi-custom units which are "batch" produced for each building project. Doors are available in narrow stile (1″ to 2¼″), medium stile (2½″ to 3½″) and wide stile (4″ to 8″).

Flush panel doors and panel insert doors are produced, as noted, by some of the fabricators shown on the following pages.

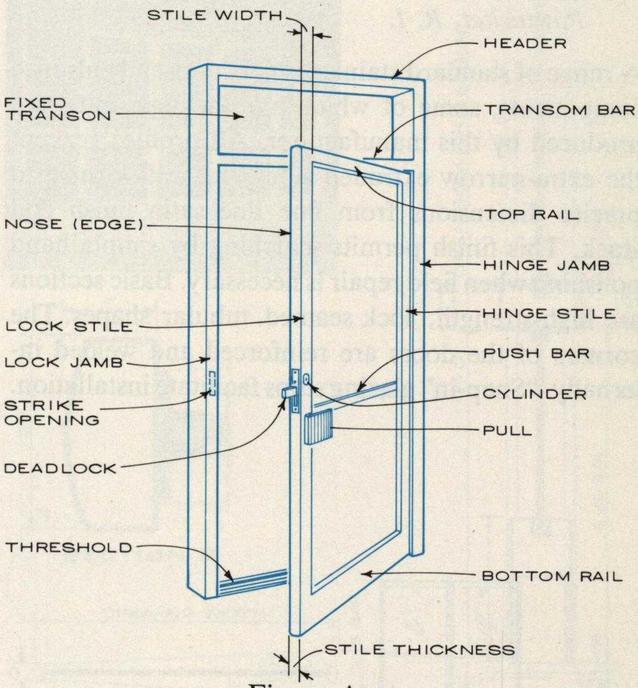


Figure A

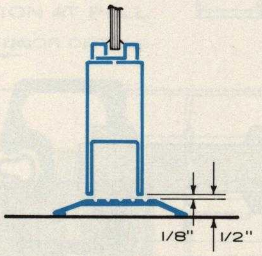
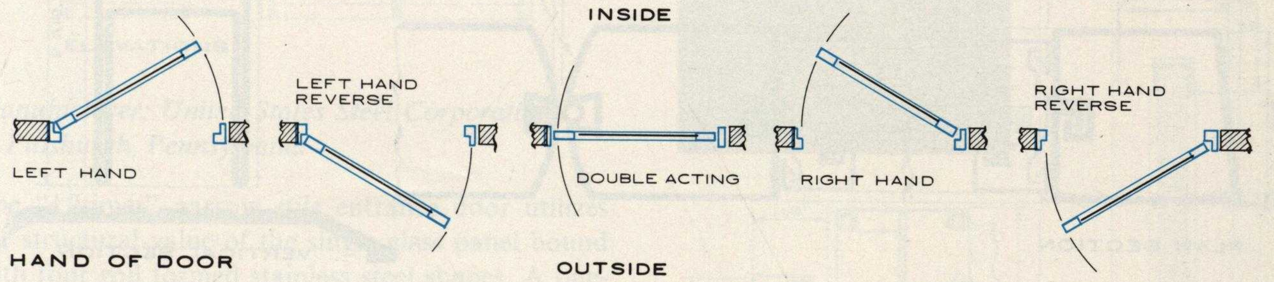
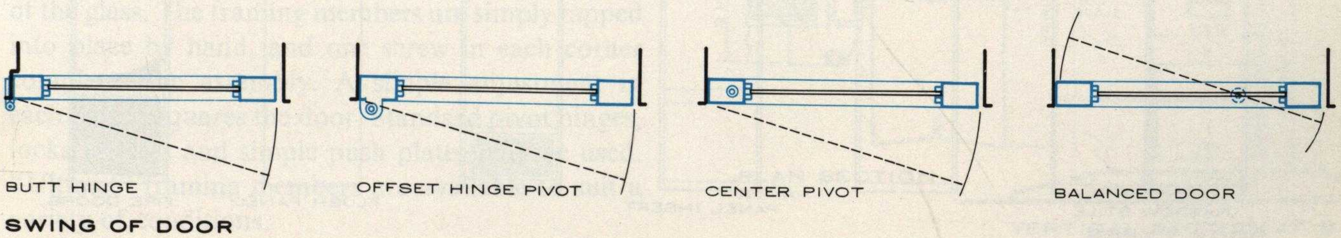


Figure B



HAND OF DOOR

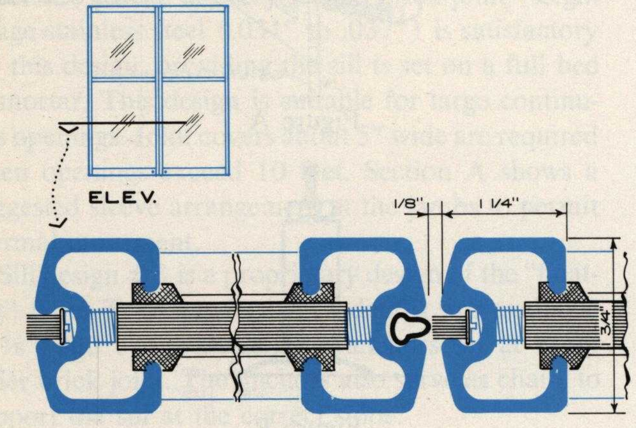


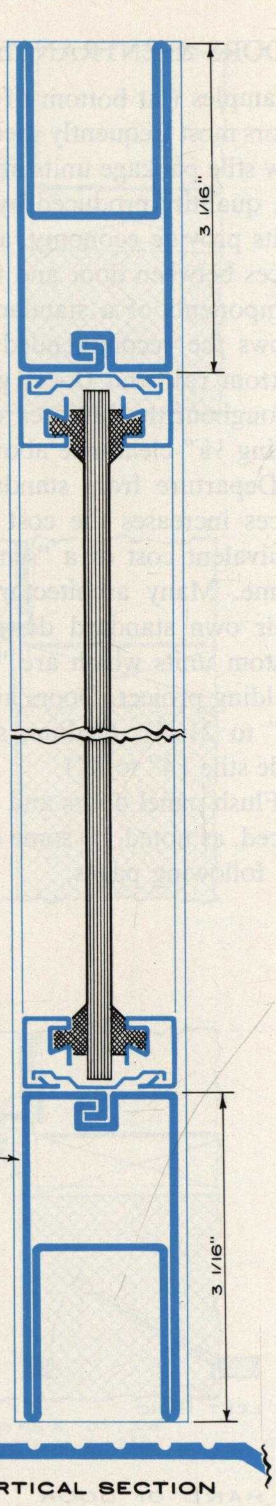
SWING OF DOOR

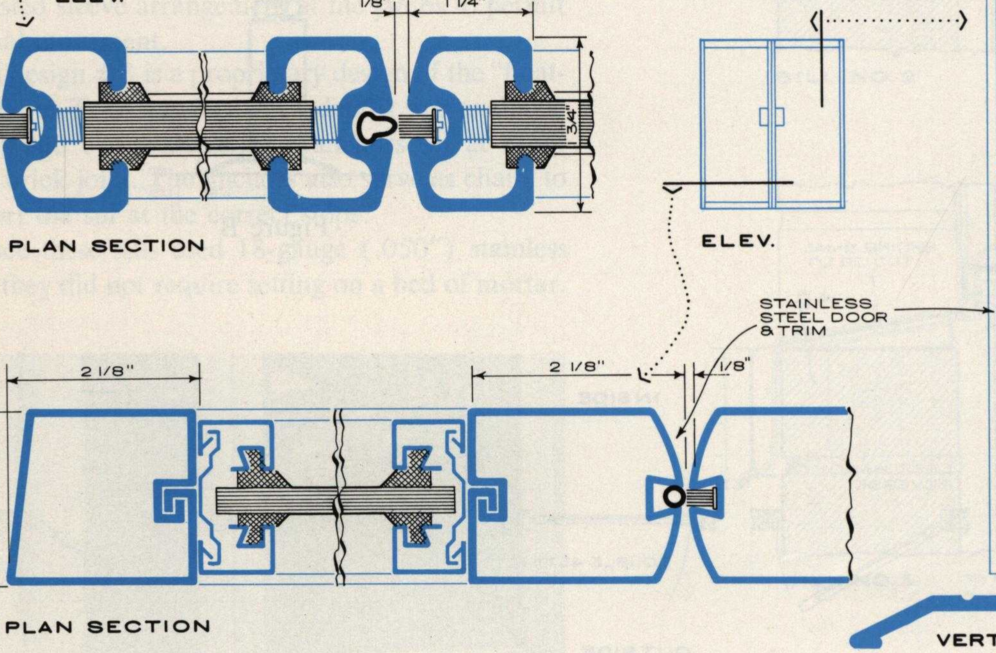
PROPRIETARY DOORS

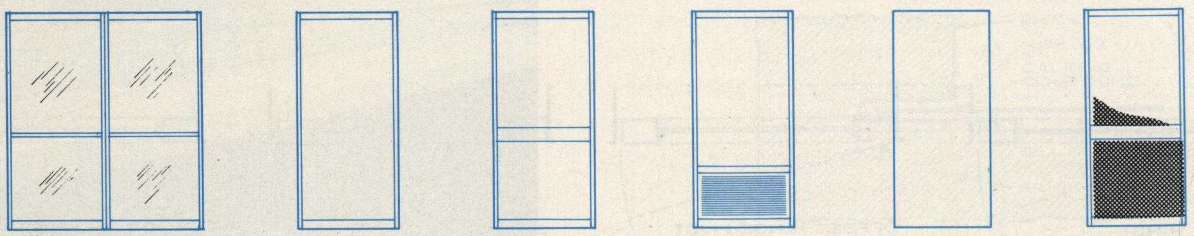
Manufacturer: The Alumiline Corporation, Pawtucket, R. I.

A range of standard stainless steel doors and entrance components, some of which are package units, are produced by this manufacturer. All profiles (except the extra-narrow extruded stiles) are roll formed to precise dimensions from fine line satin finish coil stock. This finish permits matching by simple hand polishing when field repair is necessary. Basic sections are high-strength, lock seamed, tubular shapes. The corners of the doors are reinforced and welded internally. "Snap-in" glazing stops facilitate installation.







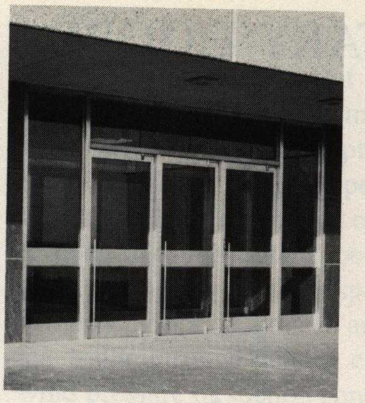


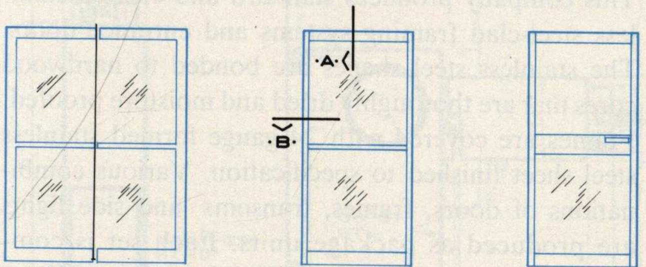
DOOR TYPES

PROPRIETARY DOORS

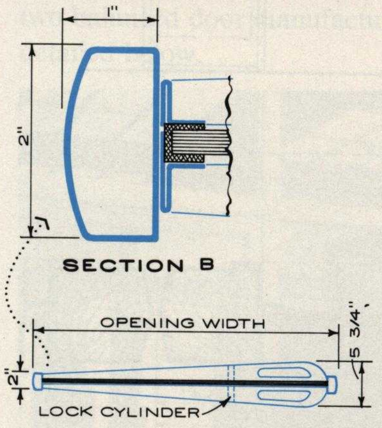
Manufacturer: Schacht Associates Inc., New York

Only a few examples from the wide range of stainless steel entrance doors and frames manufactured by this company are shown. Note the slender stiles shown in Section B. Doors can be equipped with the unique push/pull bars containing latching and locking devices shown in the Plan Section below. Also available is a completely flush glazed, heavy duty, all-welded custom door. Balanced doors are equipped with proprietary "Roto-Swing" hardware for ease of operation despite wind or stack draft conditions. Special features such as concealed door checks, finger guards, panic devices, power assist and fully automatic openers are available.



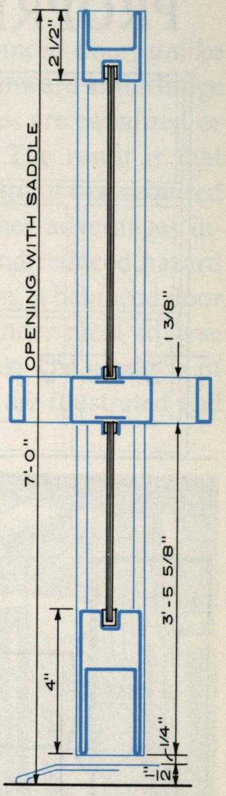


FULITE TWINSTILE IMPERIAL
ELEVATIONS



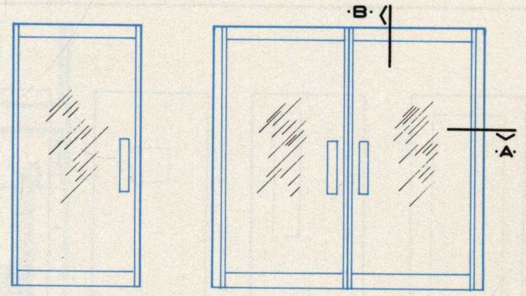
SECTION B

PLAN SECTION AT PULL



VERT. SECTION AT ·A·

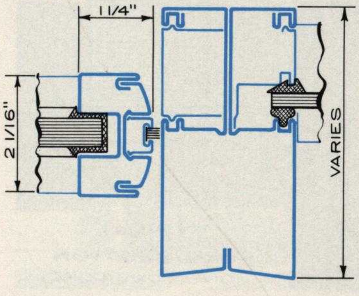
TWINSTILE DOOR DETAILS



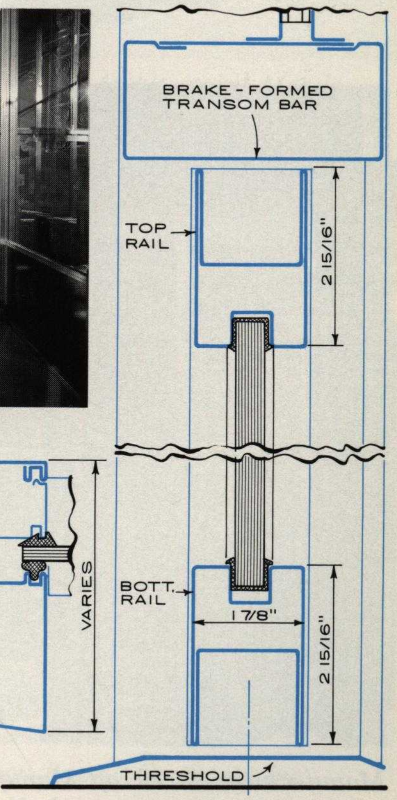
ELEVATIONS

Manufacturer: United States Steel Corporation, Pittsburgh, Pennsylvania

The "Ultimet" narrow stile entrance door utilizes the structural value of the single glass panel bound with four roll formed stainless steel shapes. A one-piece channel gasket is fitted around the perimeter of the glass. The framing members are simply tapped into place by hand, and one screw in each corner completes the assembly. A simple adjustment in each corner squares the door. Standard pivot hinges, locks, closers and simple push plates may be used. "Ultimet" framing members are available to suit a variety of conditions.

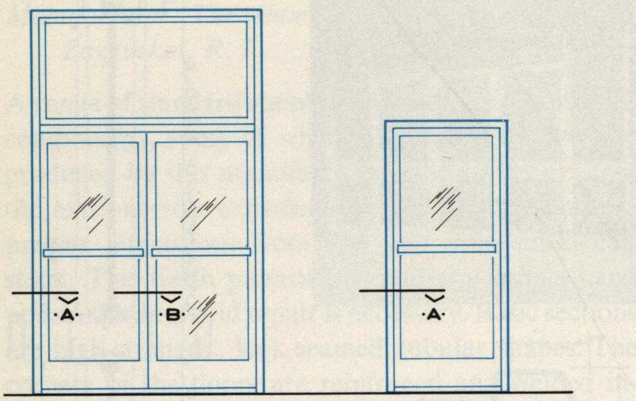


PLAN SECTION AT ·A·

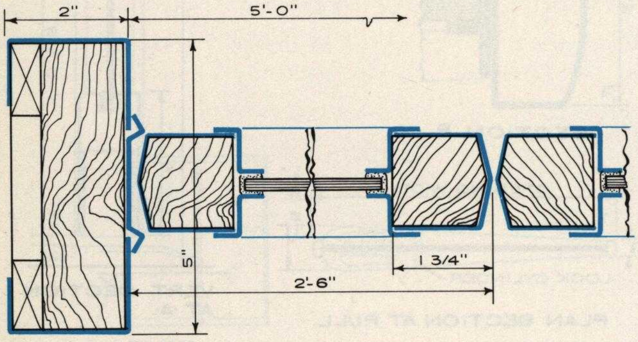


VERTICAL SECTION AT ·B·

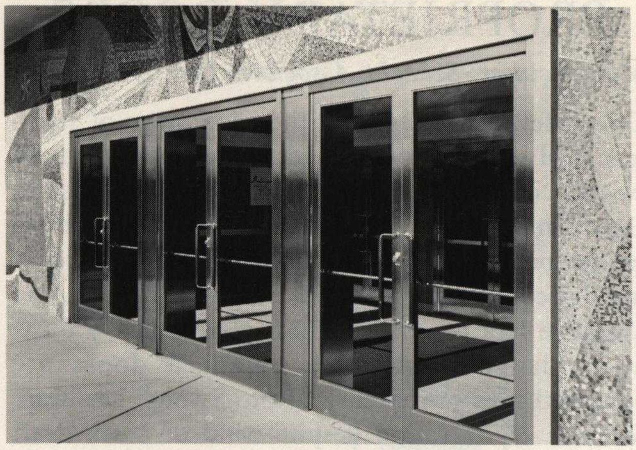
PROPRIETARY DOORS



ELEVATIONS

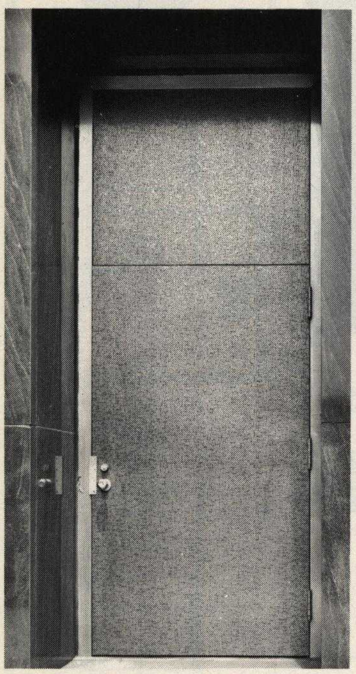


PLAN SEC. AT ·A· ·B·

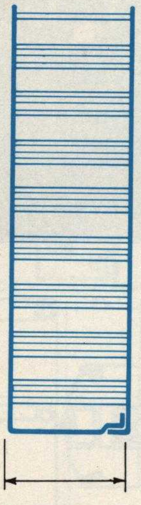


Manufacturer: L. W. Kennedy Company, Detroit, Michigan

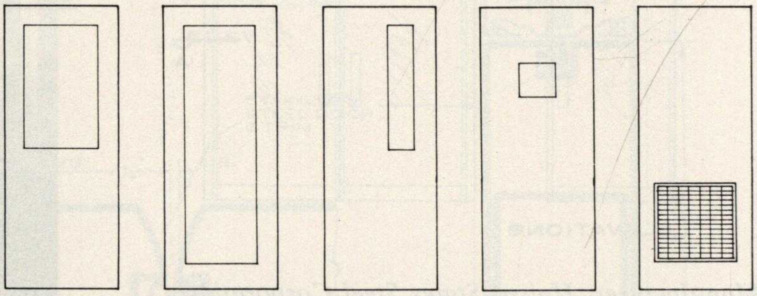
This company produces standard and custom stainless steel-clad framing systems and entrance doors. The stainless steel shapes are bonded to hardwood cores that are thoroughly dried and moisture proofed. Frames are covered with 24-gauge formed stainless steel sheet finished to specification. Various combinations of doors, frames, transoms and side lights are produced as package units. Each set is completely factory assembled. The frames are disassembled and shipped knocked down. The doors are packed separately. Doors can be pre-fitted with glass and hardware.



Manufacturer: Steelcraft Manufacturing Company, Cincinnati, Ohio



TYPICAL PLAN SECTION (HONEYCOMB CORE)

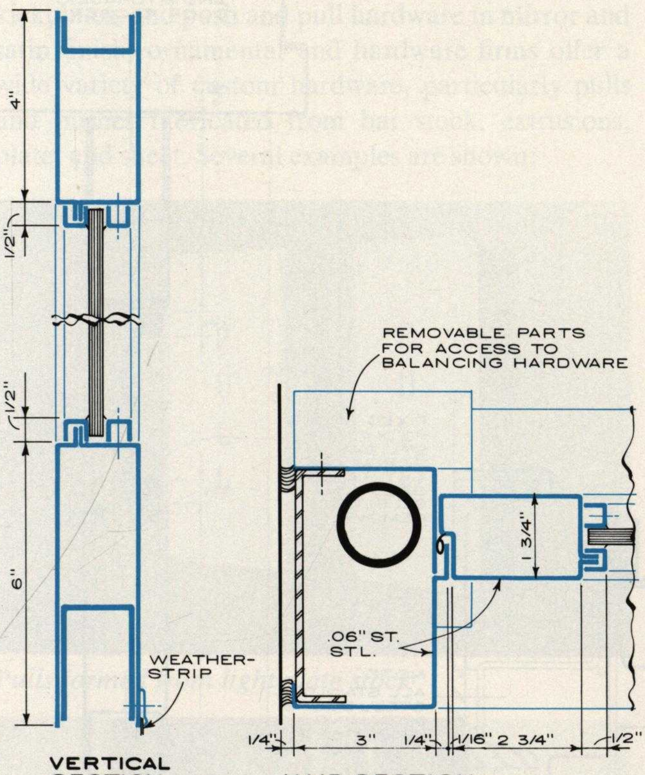


VARIOUS ELEVATIONS

Steelcraft stainless steel flush doors are reinforced, stiffened, sound-deadened, and insulated with an impregnated kraft honeycomb core bonded to the inside faces of the panels. Type 304, 20-gauge stainless steel with a No. 4 finish is standard. Extra-heavy-duty doors utilize 18-gauge stainless steel. In addition, standard door frames to suit all wall conditions are available. Steelcraft doors can be prepared for all types of stainless steel hardware and are available in standard heights from 6 to 8 feet and standard widths of 2 to 4 feet. Thickness is 1¾″ for all standard sizes and 1⅜″ in the small size range.

BALANCED DOORS

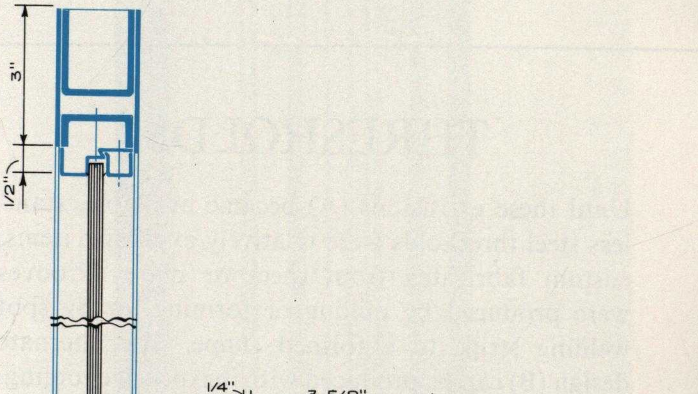
Approximately one-third of a balanced door, unlike a conventional swing door, moves inward at the hinge stile. Interior and exterior pressures are equalized or balanced as the door is opened. The result is that opening effort is only about one-third of that required to open a conventional door. Other advantages include savings in vestibule space and reduced hazard of sidewalk obstruction. In addition, a balanced door lets traffic through quickly even under most adverse wind pressure or suction conditions. The products of two balanced door manufacturers are illustrated and detailed below.



VERTICAL SECTION

JAMB SECTION

Manufacturer: Flour City Architectural Metals, Minneapolis, Minn.



VERT. SEC.

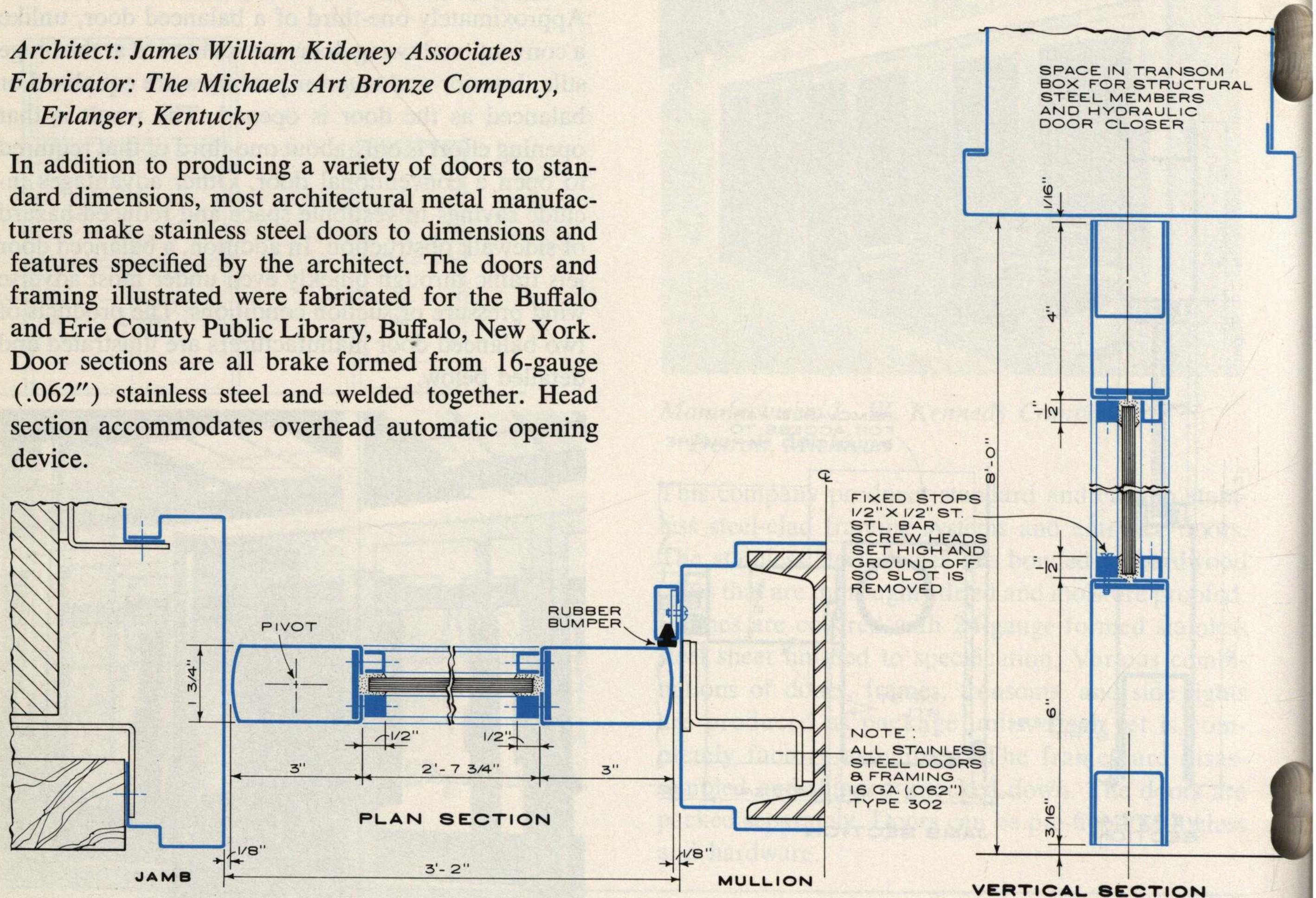
JAMB SECTION

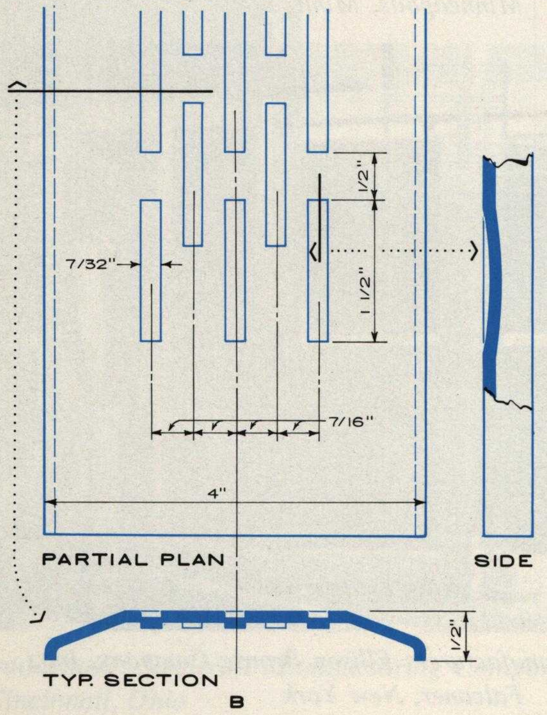
Manufacturer: Ellison Bronze Company, Inc., Falconer, New York

CUSTOM DOORS

Architect: James William Kideney Associates
Fabricator: The Michaels Art Bronze Company, Erlanger, Kentucky

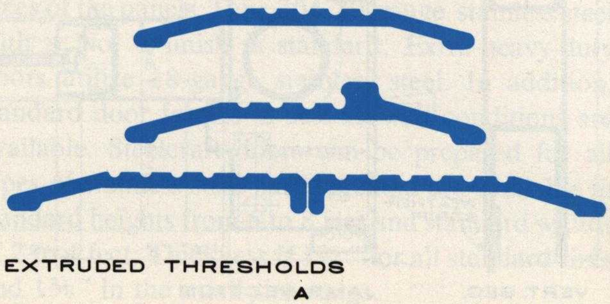
In addition to producing a variety of doors to standard dimensions, most architectural metal manufacturers make stainless steel doors to dimensions and features specified by the architect. The doors and framing illustrated were fabricated for the Buffalo and Erie County Public Library, Buffalo, New York. Door sections are all brake formed from 16-gauge (.062″) stainless steel and welded together. Head section accommodates overhead automatic opening device.





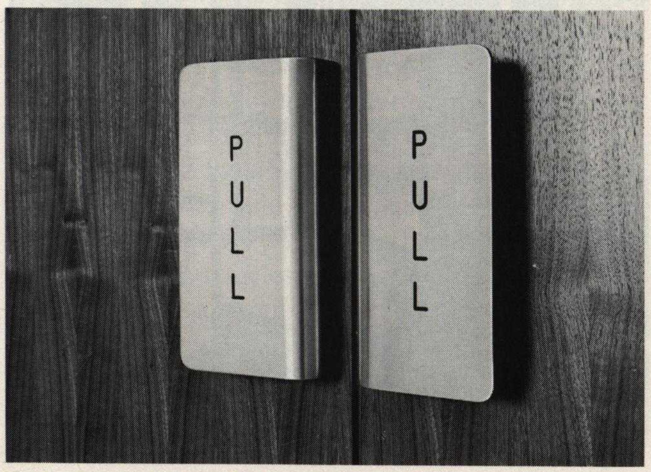
THRESHOLDS

Until these extrusions (A) became available, stainless steel thresholds were relatively expensive items, custom fabricated from sheet or plate. Grooves were produced by milling or forming, or by spot welding strips to a formed shape. The alternate design (B) can be produced with inexpensive tooling. An advantage of this design is that the slots can be terminated near the end of the piece to facilitate punching openings for pivots and closers.

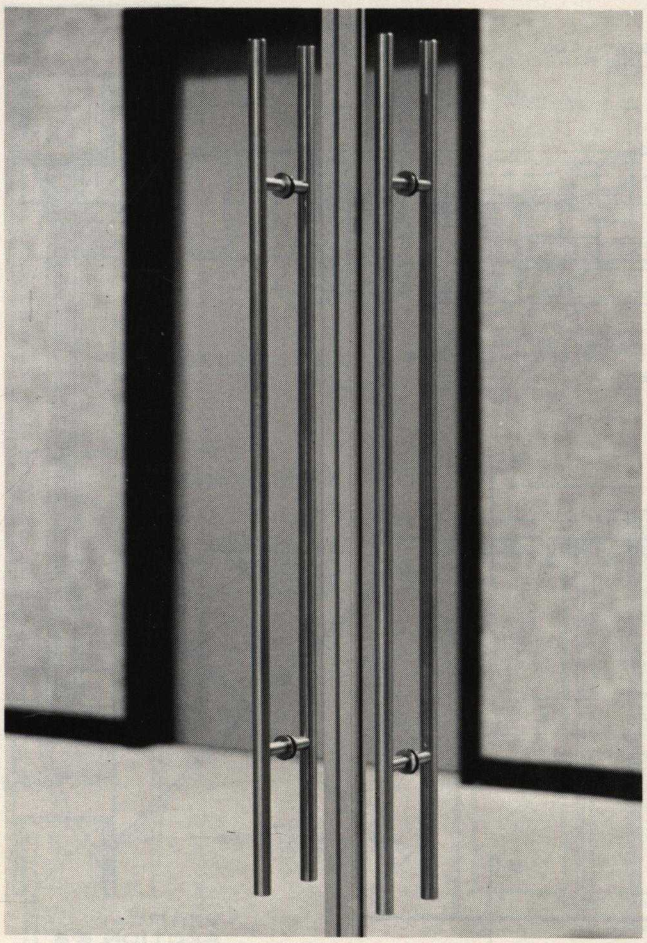


CUSTOM HARDWARE

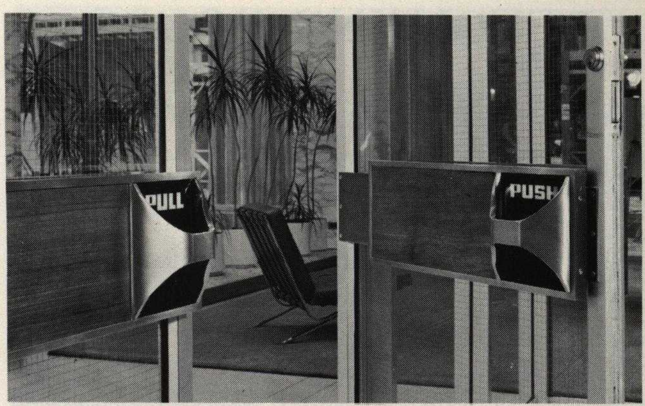
In addition to complete lines of standard builders' hardware, including locksets, panic devices, hinges, kickplates, and push and pull hardware in mirror and satin finish, ornamental and hardware firms offer a wide variety of custom hardware, particularly pulls and pushes fabricated from bar stock, extrusions, plate, and sheet. Several examples are shown:



Pulls formed from light plate stock

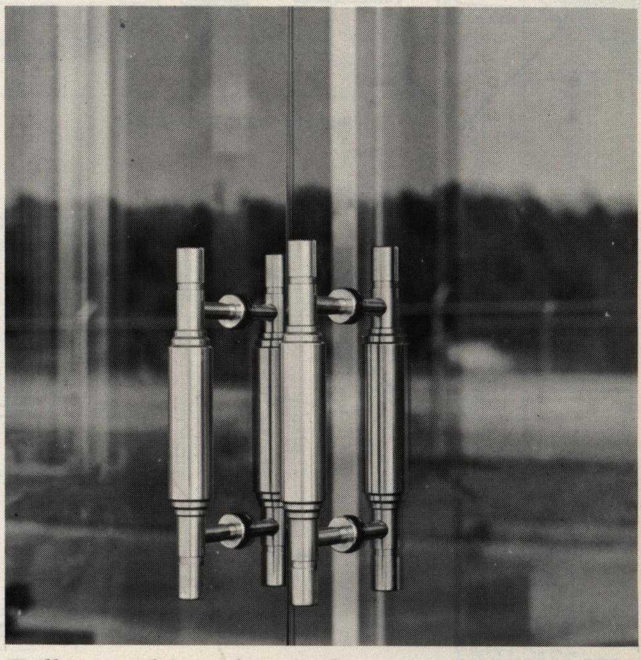


Long, slender pulls of bar stock or heavy tubing



Unusual pulls use formed plate, channels, walnut

Turned handles combined with flat and round bar



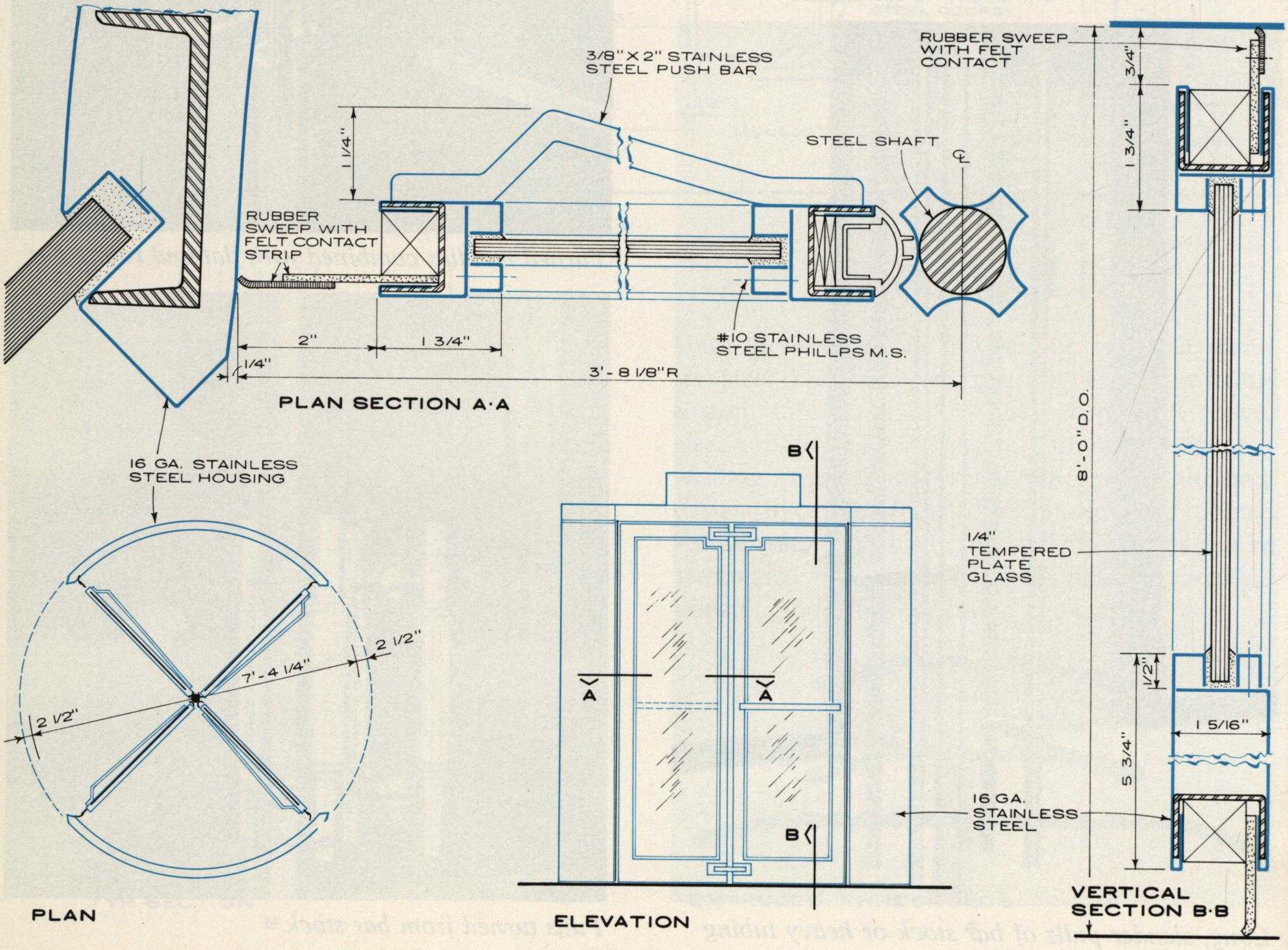
Pulls turned from bar stock

REVOLVING DOORS

MARINA CITY, CHICAGO, ILLINOIS

Architects: Bertrand Goldberg Associates, Chicago
Fabricator: Crane Fulview Glass Door Company, Deerfield, Ill.

Both standard and custom revolving doors are produced by this manufacturer. The custom door illustrated at right and detailed below is housed in an enclosure formed from 16-gauge stainless steel sheet. Standard enclosures are glazed with curved polished plate glass, and wings are glazed with safety tempered polished plate. The doors are floor supported and are equipped with a concealed speed control mechanism which can be located either overhead or in the floor. Panic devices permit the wings to collapse outward like the leaves of a closed book when excess force is applied. Models offered are Standard, Deluxe (with narrow top rail) and Maximum Vision (with very narrow rails, stiles and mullions and ⅜″ thick glazing). Surface applied bolt-type cylinder locks are standard.



PLAN SECTION A·A

PLAN

ELEVATION

VERTICAL SECTION B·B

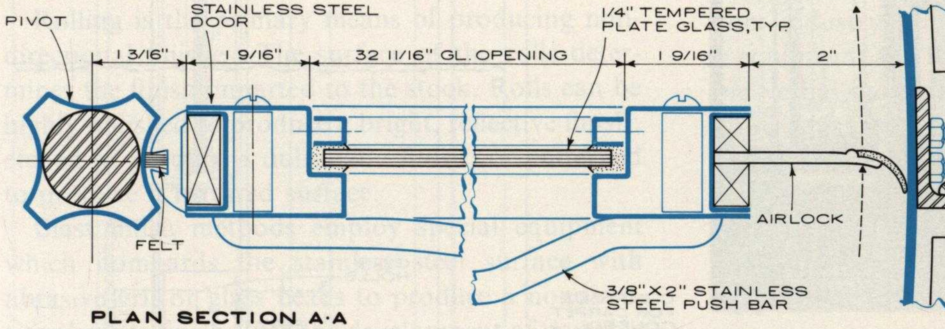
REVOLVING DOORS

Stainless steel revolving doors by this manufacturer are fabricated from 16-gauge Type 302 stainless steel sheet. Standard models are produced in four sizes, while custom doors, such as the unusual ten-foot high revolving door with an all stainless steel enclosure illustrated on this page, are produced to architects' specifications.

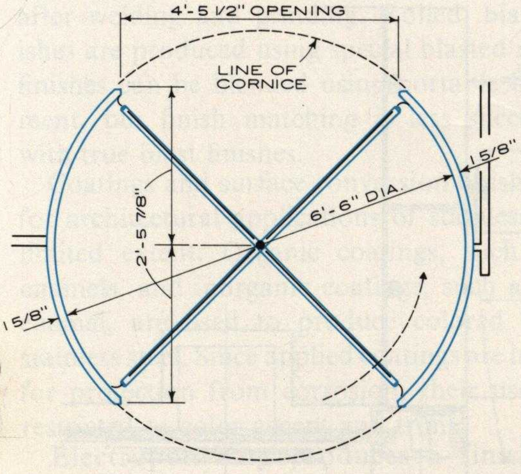
The emergency collapsing mechanism utilizes a stainless steel ball and socket holding device to assure that corrosion will not impair proper functioning. Surface mounted locks with standard cylinders and concealed overhead speed control mechanism are standard equipment. A No. 4 natural satin finish is standard for doors and frames, and all exposed hardware and fittings are polished to blend with the finish of the wings and enclosure.

Available as an option is patented "Revolvomatic" power control, which reduces operating effort to fingertip pressure and automatically aligns the wings at the quarterlines.

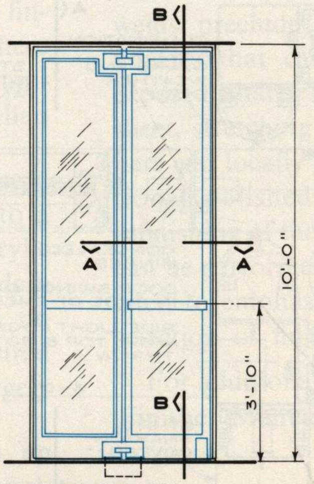
COVENANT CLUB, CHICAGO, ILLINOIS
Architects: Bertrand Goldberg Associates, Chicago
Fabricator: Revolving Door Division, International Steel Company, Evansville, Ind.



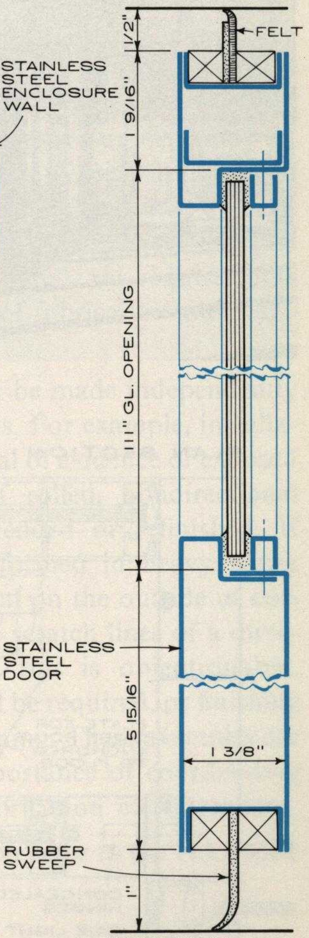
PLAN SECTION A·A



PLAN



ELEVATION



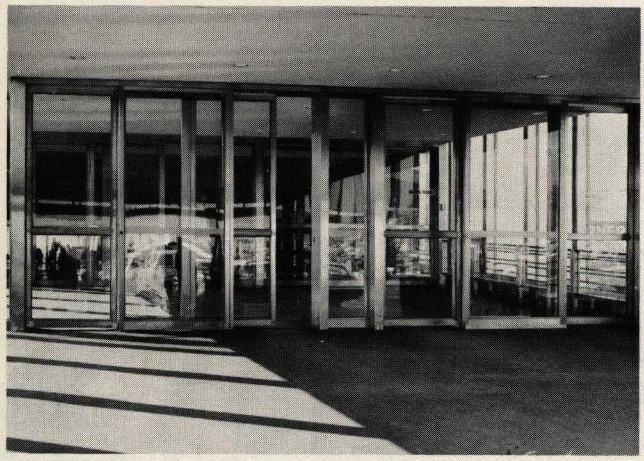
VERTICAL SECTION B·B

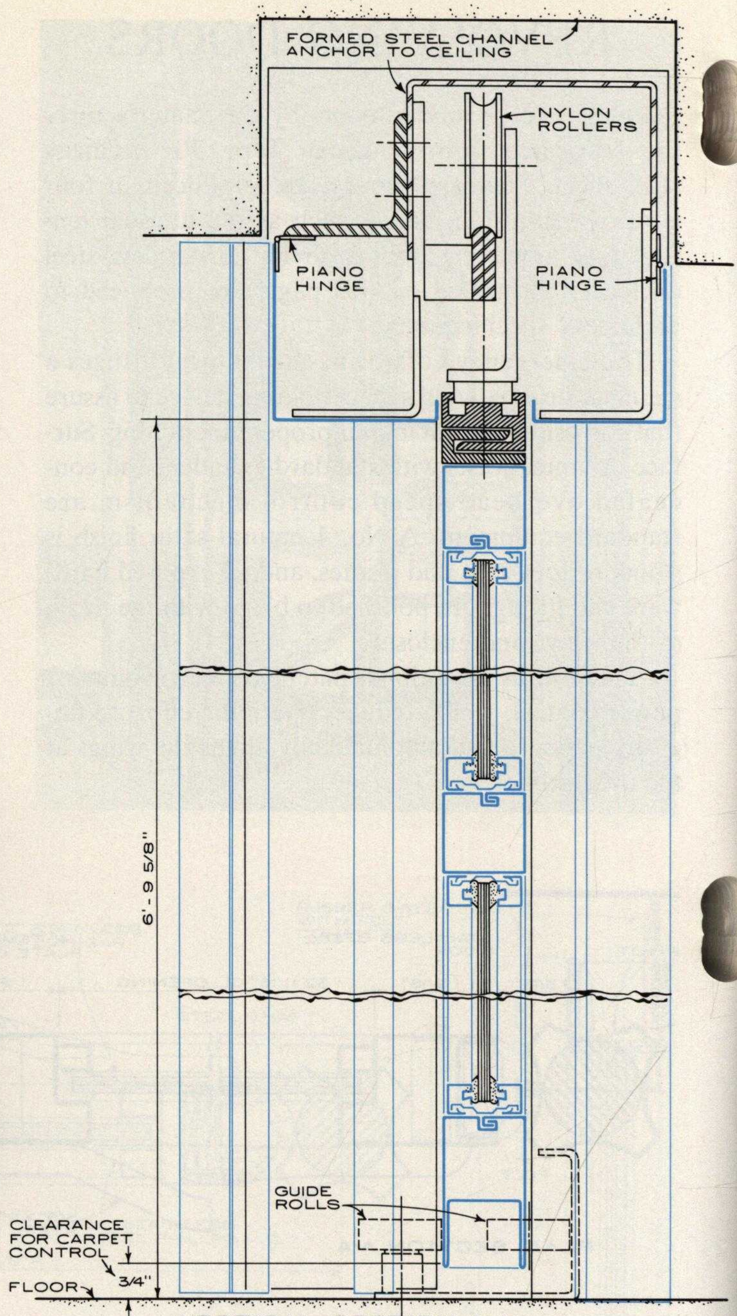
SLIDING DOORS

AMERICAN AIRLINES TERMINAL BUILDING NATIONAL AIRPORT, WASHINGTON, D.C.

Architects: Giuliani Associates, Washington, D.C.
Manufacturer: The Stanley Works, New Britain, Conn.

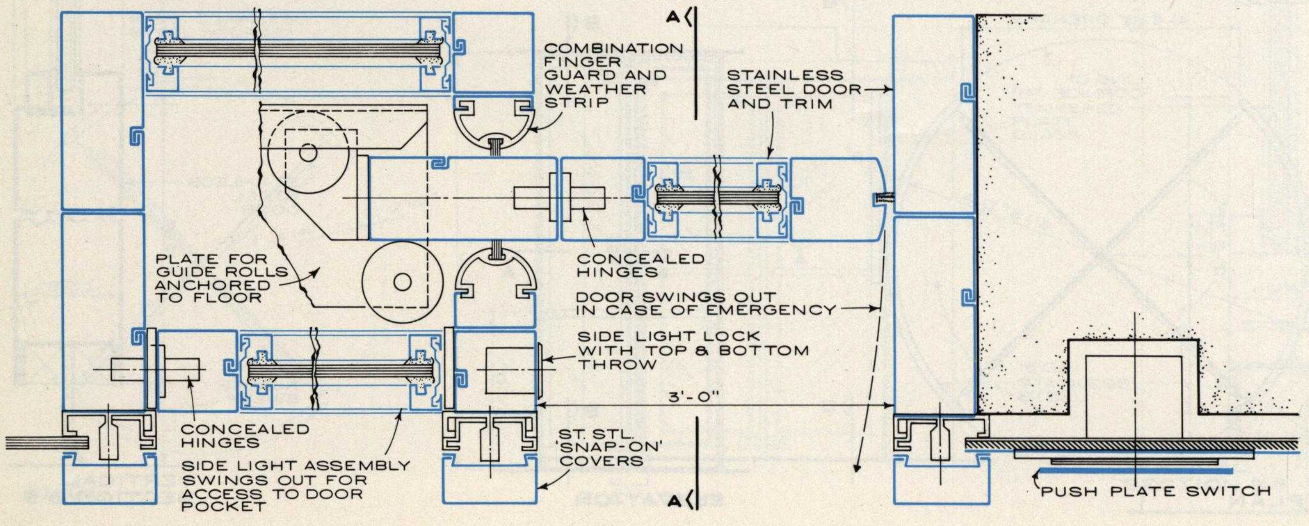
Automatically operating sliding doors present a compact, functional solution for entrances which must accommodate two-way traffic. The sliding leaves retract into enclosed pockets and offer no interference with traffic approaching from either side. Concealed hinges permit the door to swing out 90° in case of emergency to conform to exit codes. Automatic sliding doors are available as single doors or as bi-parting double doors. The outer sidelight assembly is normally locked, but may be swung out to clean the glass or perform other maintenance. Doors may be operated by either a floor treadle or a wall-mounted push plate switch.





VERTICAL SECTION A·A

PLAN SECTION



FINISHES

The unique combination of bright luster and inherent resistance to corrosion is often the reason stainless steel is selected for ornamental architectural metalwork. Because of this exceptional combination of properties, MECHANICAL FINISHES, which physically alter the surface of the metal by abrasion or deformation, are predominantly specified. However, COATINGS or CHEMICAL and ELECTROCHEMICAL FINISHES, which include painting and porcelain enameling, acid etching, electropolishing and oxide conversion surface coloring, are also used to a limited extent in architecture.

Mechanical finishes are produced by three basic methods. These are (1) polishing or buffing with abrasive wheels, belts or pads; (2) rolling between polished or textured rolls; and (3) blasting with abrasive grit or glass beads.

Abrasive polishing produces a series of approximately parallel scratches which impart a strong directional character to the finish. Buffed finishes are applied to polished surfaces by using rouges under cloth buffing wheels. Buffing increases reflectivity and reduces the directional character of the finish.

Rolling is the primary means of producing nondirectional finishes. The surface of the rolls determines the finish imparted to the stock. Rolls can be highly polished to produce a bright, reflective finish; etched to produce a dull matte finish; or patterned to produce a textured surface.

Blast finish methods employ special equipment which bombards the stainless steel surface with abrasive grit or glass beads to produce a nondirectional matte finish. With the development of portable blast equipment, blast finishes offer the advantage of blendability and permit shop or field refinishing after welding and grinding. Rolled, blast-type finishes are produced using special blasted rolls. These finishes can be blended using portable blast equipment, but finish matching is less successful than with true blast finishes.

Coatings and surface conversion finishes are used for architectural applications of stainless steel to a limited extent. Organic coatings, such as acrylic enamels, and inorganic coatings, such as porcelain enamel, are used to produce colored finishes on stainless steel. Since applied coatings are not required for protection from corrosion, their use is largely restricted to color accent and trim.

Electropolishing produces a finish with an extremely bright luster on either polished or unpolished surfaces by means of a simple electrolytic bath. Oxide conversion coatings are produced by carefully controlled chemical and heat treatment of the metal surface. This process provides colors ranging from pale gold through bronze and gray to black. A matte finish can be produced by acid etching.

Finishing can be performed at any of several stages in the production/fabrication/installation sequence. Sheet and strip products are available from stock in a choice of standard mechanical finishes. (See page 2 of the Mill Products section.) In addition, producers offer a variety of proprietary rolled and polished finishes with advantages over standard mechanical finishes such as lower reflectivity to improve visual flatness or improved blendability for easier refinishing.

Certain fabricators or processors roll proprietary deep embossed finishes on sheet stock. These textured finishes have a distinctive appearance and improve visual flatness. Deep embossing adds stiffness and can permit use of thinner gauge stock.

The fabricator usually finishes or refinishes assemblies or components to meet specified appearance requirements or to remove tool or weld marks. Since fabricator finishes vary slightly but perceptibly from industry standards due to minor differences in equipment and finishing techniques, specifications and verbal descriptions should be supplemented by actual finish samples to assure desired appearance.

Selection of finish is normally determined by both functional and esthetic requirements. Among the factors that must be considered are requirements for visual flatness, method of fabrication and viewing position and distance.

Selection of finish cannot be made independently of fabrication considerations. For example, installations that require the removal of evidence of exposed welds preclude the use of rolled, nondirectional finishes that cannot be blended or refinished. If exposed sharp bends are formed in heavy gauge sheet, stretching of the metal on the outside of corners can locally remove the scratch lines of a directional polished finish. If this is objectionable, refinishing of the corner will be required, or finishing can be performed after forming. These examples are cited to emphasize the importance of coordinating selection of finish with fabrication considerations.

For additional information refer to the NAAMM Finishes Manual.

FLAGPOLES

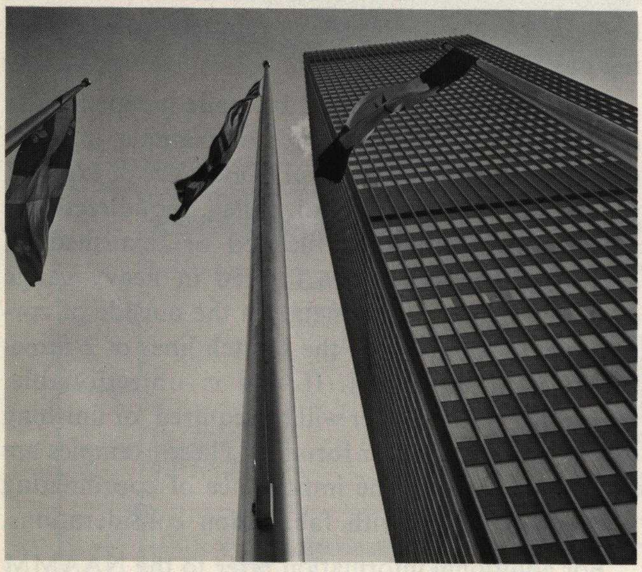
Shape is one of the first factors that architects consider when selecting a flagpole. The main shapes used are:

(1) Venetian entasis tapered
(2) Cone tapered (straight or continuous tapered)
(3) Step tapered (telescoped or sectional)
(4) Cylindrical (straight sides)

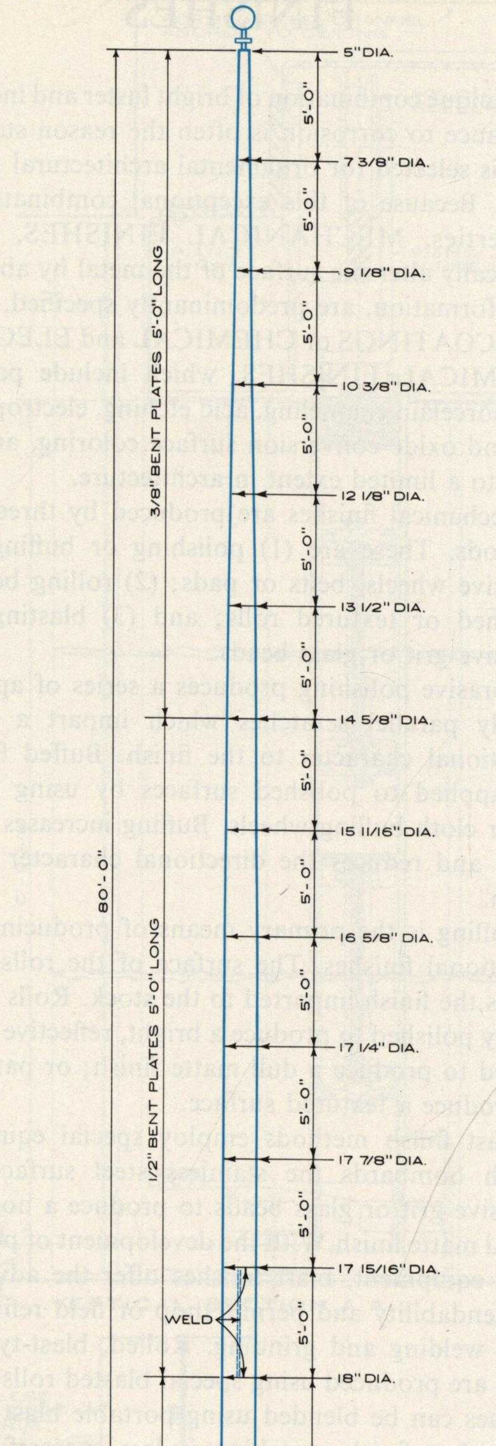
Venetian entasis tapered poles, although expensive to fabricate, are considered the most esthetically pleasing and, therefore, are used in prestige settings that require long poles visible from afar. Entasis, a light outward curve in a vertically tapering surface, counteracts the optical illusion of concavity which occurs when a cone tapered pole is viewed from a distance.

The 80-foot stainless steel Venetian entasis tapered poles (shown) are 18″ in diameter at the base, 16⅝″ diameter at the midpoint, and 5″ at the top. A cone tapered pole having the same base and top diameter as above would be only 11½″ in diameter at the midpoint. The 5-foot sections were formed in two semi-cylindrical tapered shells of Type 304 stainless steel, welded continuously (90°V) on the vertical and circumferential joints. All welds were ground flush and the complete pole polished to a fine-line finish.

Stock sectional stainless steel flagpoles are available up to 25 feet in height. These are available as a package unit including hardware, rope and ground mounting socket.



CANADIAN IMPERIAL BANK OF COMMERCE, MONTREAL
Fabricator: A. Faustin Ltd., Montreal



MARQUEES & CANOPIES

RIVERDALE HOSPITAL, TORONTO, ONTARIO

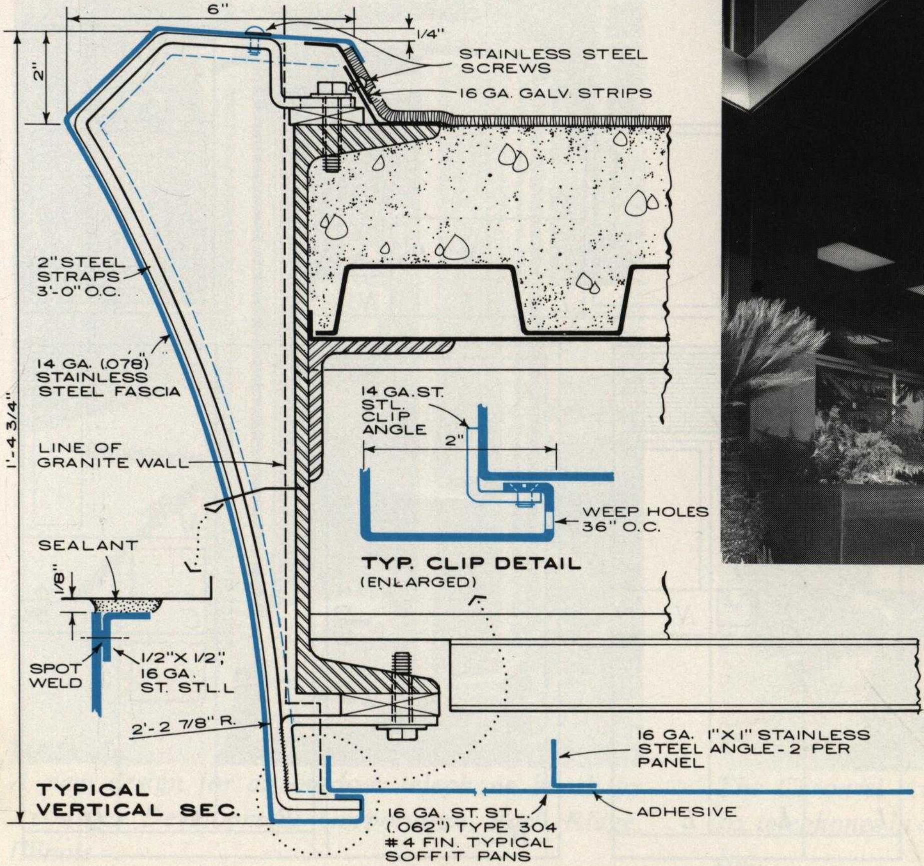
Architects: Chapman and Hurst, Toronto
Fabricator: Canadian Rogers Eastern Ltd., Toronto

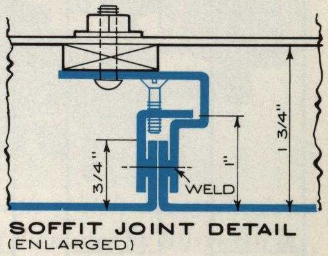
Six stainless steel-trimmed "mushrooms," varying in diameter from 15 to 30 feet and from 8′-6″ to 13′-6″ in height, form a colonnaded walk to the main entrance of this hospital. The stainless steel column covers were brake formed in two halves and welded together. The welds were ground and polished to match the original finish. A large stainless steel flange caps each column.

KIRKEBY CENTER, WESTWOOD, CALIF.

Architects: Claude Beelman and Kent Attridge, Los Angeles
Fabricator: Cochran-Izant and Co., Los Angeles

Note the curvature of the deep facia of this main entrance canopy. The soffit panel detailing is also shown (lower right).





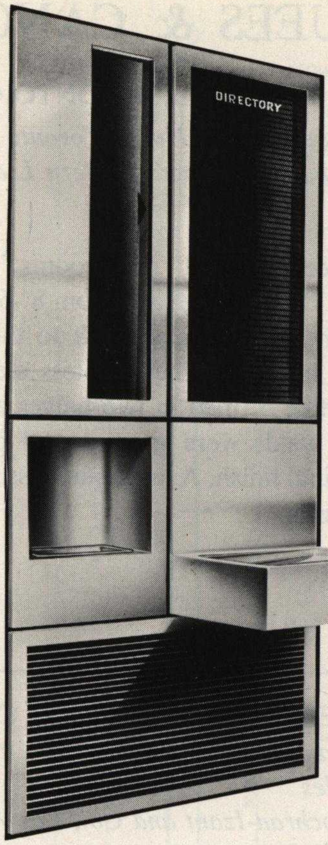
SERVICE MODULES

Manufacturer: C E B Limited, Toronto, Ontario

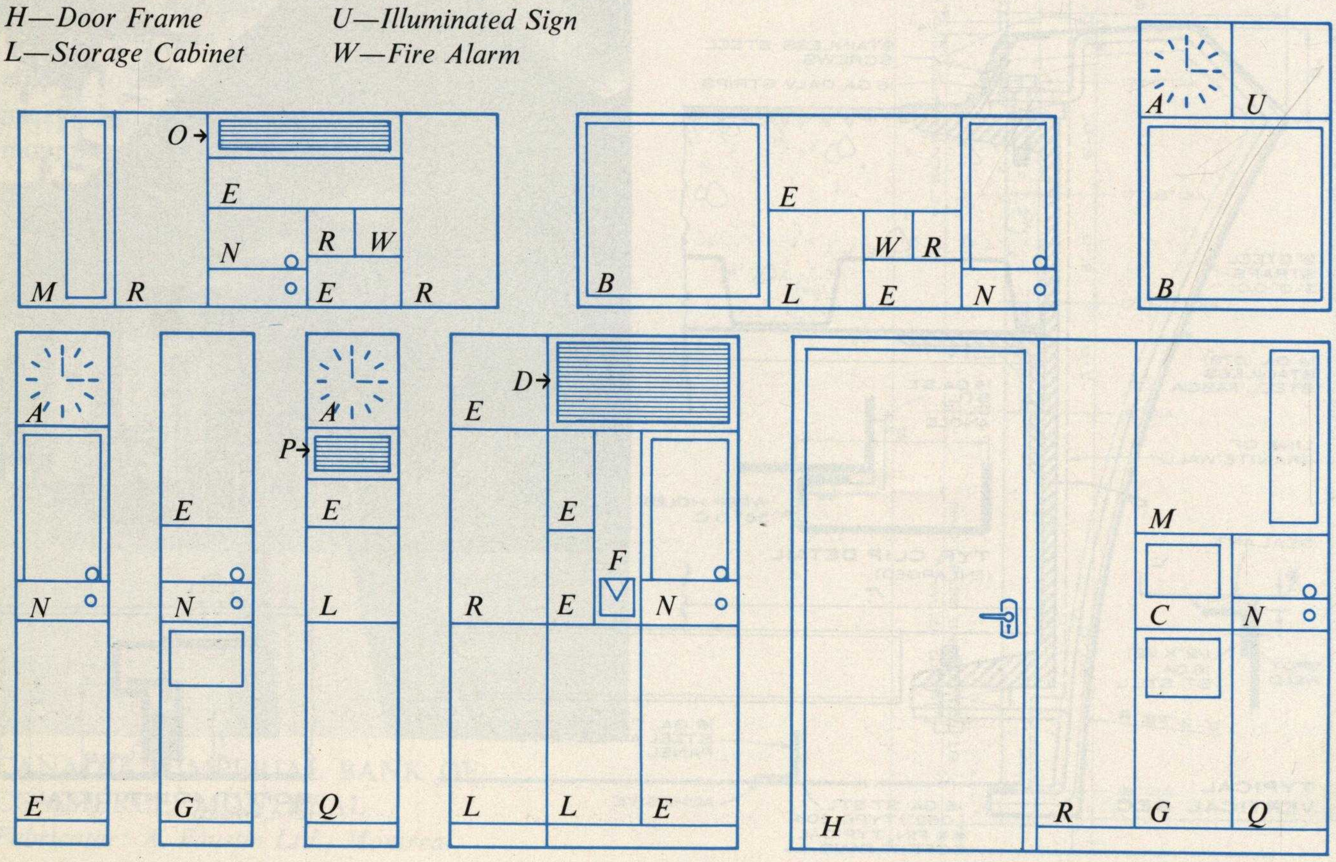
The development of the service module system permits unique flexibility in combining various architectural, mechanical and electrical services within a single modular housing.

The housings are based on a 4″ module and can be used individually or in a great variety of modular groupings. Over two hundred components are available from the manufacturer in stainless steel or in a combination of painted steel and stainless steel. The designer may select items and sizes to suit building requirements.

Space-saving modular combinations include any of the following: fire hose and extinguisher cabinet, drinking fountain, ash tray, waste disposal, electric clock, mail chute, electric circuit panel cover, telephone alcove, door, janitor sink, air supply and return grilles, and so forth.



A—Clock
B—Directory Board
C—Ash Tray
D—Air Supply Grille
E—Access Door
F—Cup Dispenser
G—Waste Receptacle
H—Door Frame
L—Storage Cabinet
M—Fire Hose and Extinguisher Cabinet
N—Drinking Fountain
O—Air Return Grille
P—Speaker Grille
Q—Janitor's Sink
R—Filler Panel
U—Illuminated Sign
W—Fire Alarm

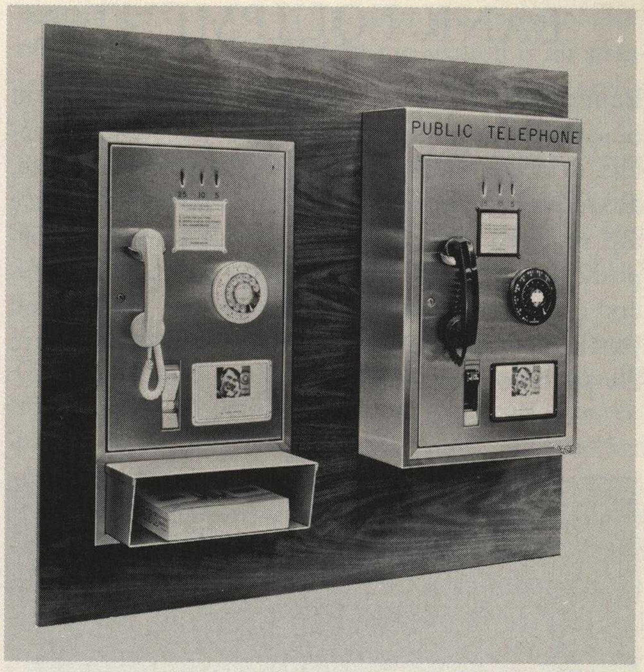


TELEPHONE BOOTHS

The selection of telephone booth design is the responsibility of architects and telephone operating companies. Perforated or textured and perforated stainless steel sheet is widely used to provide a durable acoustical lining material for booths. Coin telephone panels, writing and directory shelves, structural trim and panel elements are also designed in stainless steel.

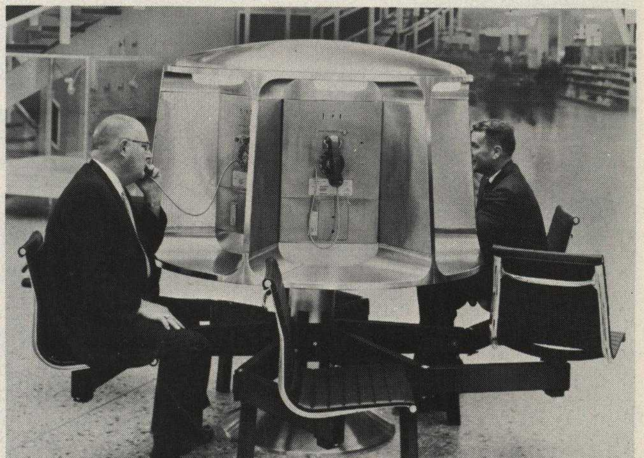
O. M. Edwards, Slimvue 333 booths installed in the R.C.A. Building, 60 Broad Street, New York

A new design for an outdoor telephone booth by Acoustics Development Corporation, Park Ridge, Illinois



Model 101 recess and surface mounted panel units by Burgess-Day, Inc., Libertyville, Illinois

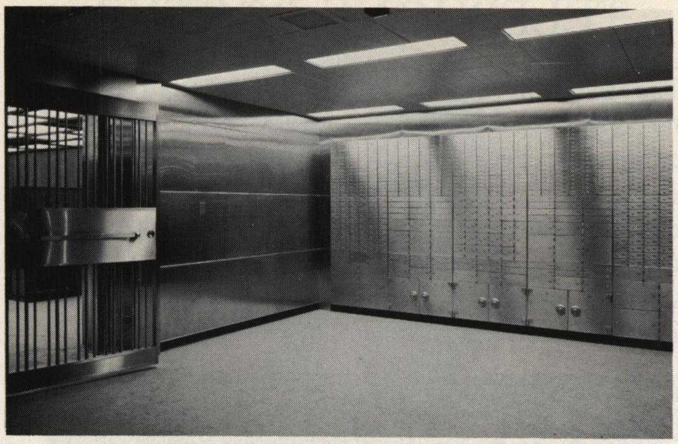
The Model 500 Acousti-Booth uses stainless steel tubing frames by Burgess-Day, Inc.

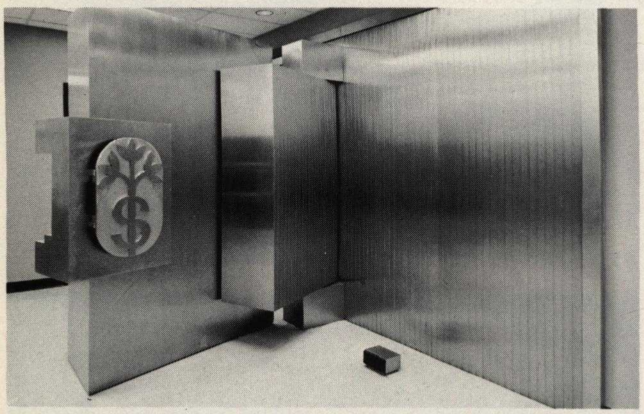


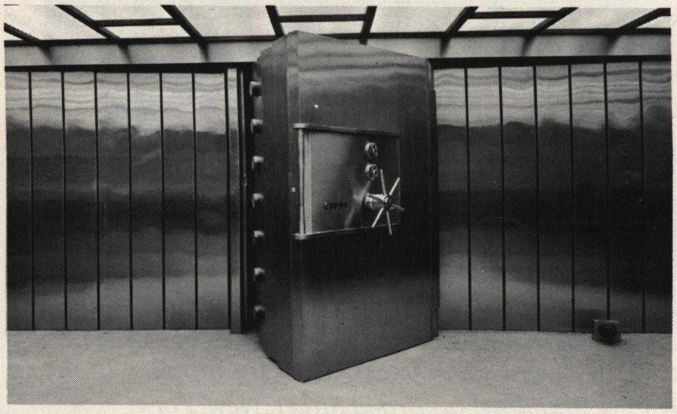
The Carousel Acousti-Booth which accommodates six telephones in a five-foot diameter by Burgess-Day, Inc.

BANK EQUIPMENT

Banks were among the pioneers in the development of stainless steel for architectural applications. Stainless steel continues to be preferred where strength, attractive appearance, security and low maintenance are required. Stainless steel is widely used for depositories, drive-in windows, lock boxes, safes, tellers' cages, counters, windows, grilles, vaults and partitions. A number of these applications are illustrated on this page.







SPIRES

Neglected maintenance, usually due to high cost, has often necessitated complete replacement of spires on many churches. For this reason, stainless steel is a wise choice of material for both renovation and new construction. It may be used for structural elements, for external cladding, or both. Whether design is traditional or contemporary, stainless steel spire construction follows three basic types:

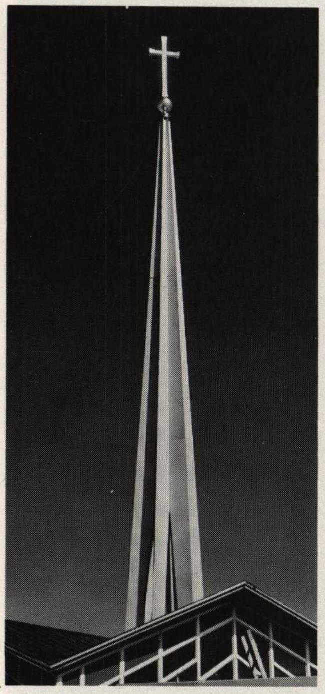
1. Heavy (10- to 16-) gauge skin used as both structural and cladding elements, supplemented if necessary by stainless steel or structural steel internal members.
2. Light (18- to 20-) gauge stainless steel used as a cladding over wooden sheathing applied to wood or steel structural framing members.
3. Stainless steel used in structural or sculptural form with or without tracery or grille work.

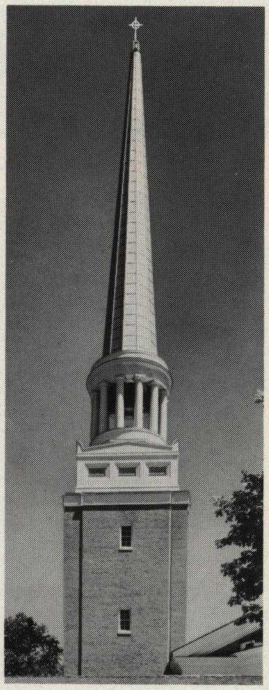
Figure A is an example of Type 1. It was shop fabricated in three sections which were lifted by crane and bolted together. The covering members of 10-gauge, Type 304 stainless steel form a hexagonal star-shaped cross section. The two bottom sections contain six 5″ x 3″ x ¼″ tubular structural columns of Cor-ten steel. The 23-foot top section is all stainless steel topped with a 24″ stainless ball and a 10-foot cross.

Figure B represents Type 2 construction. It is clad with light-gauge, Type 302 stainless steel utilizing a batten roofing system. This 85-foot spire is surmounted by a caged beacon light and a stainless steel cross.

A modern example of Type 2 construction, Figure C, takes the form of a letter "A" 55 feet high. Its structural steel framing is hidden by precast concrete panels on the outside sloping faces and stainless steel sheathing on all other surfaces. The cap is 16-gauge, Type 304 stainless steel of welded construction. All other stainless surfaces are 20-gauge sheet bonded to ¾″ plywood (for sound deadening and flatness) reinforced with ⅛″ bent angle stiffeners. A dull matte architectural finish was specified for all exposed surfaces.

An unusual spire of Type 3 construction, Figure D, is a modern adaptation of the familiar onion dome. Two tons of stainless steel bar and strip were welded into a continuous 50-foot structure.


A


B


C

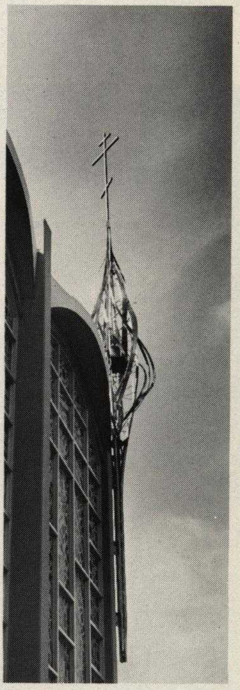

D

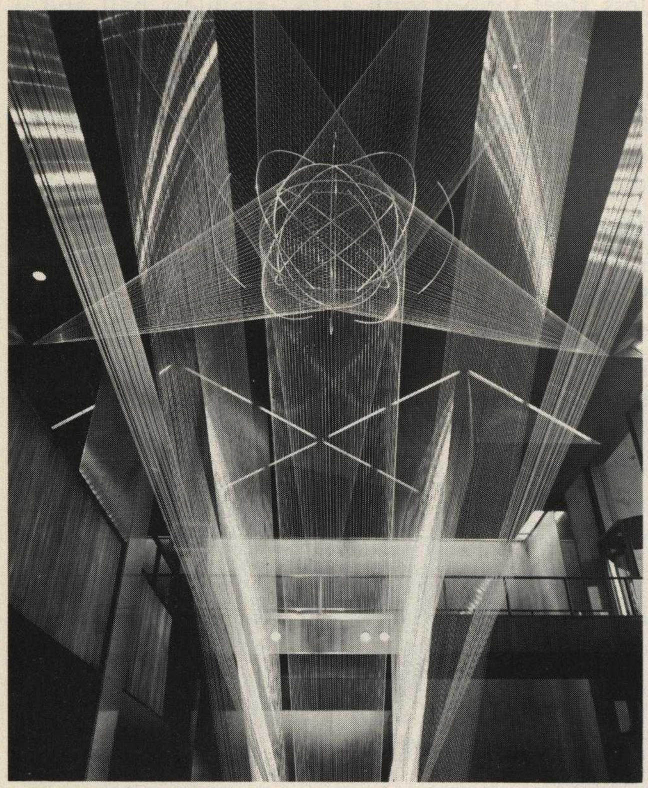
Figure A—*Spire, Madonna Hall, Marlboro, Mass.*
Architect: Maginnis, Walsh & Kennedy, Boston
Fabricator: Overly Manufacturing Co., Greensburg, Pa.

Figure B—*Spire, Goodrich Memorial Chapel, Albion College, Albion, Michigan*
Architect: Frank E. Dean, Albion, Michigan
Fabricator: Overly Manufacturing Co., Greensburg, Pa.

Figure C—*Bell Tower, St. Aloysius Church, New Canaan, Connecticut*
Architects: Van Summern and Weigold, New York
Fabricator: Shedaker Metal Arts Inc., Philadelphia

Figure D—*Mast sculpture St. Mary's Catholic Church of the Byzantine Rite, New York City*
Sculptor: Jan Peter Stern

SCULPTURE & FURNITURE



Sculpture—"Flight," by Richard Lippold, Pan Am Building, New York

Furniture Grouping—solid stainless steel bar stock legs, with mirror finish—Thonet Industries, Inc., New York

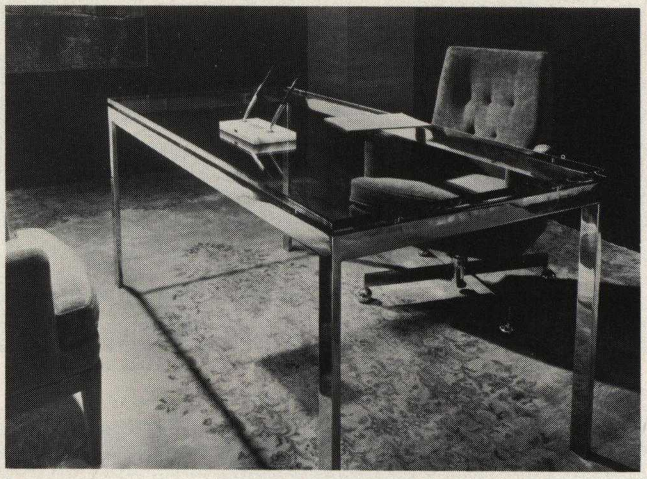
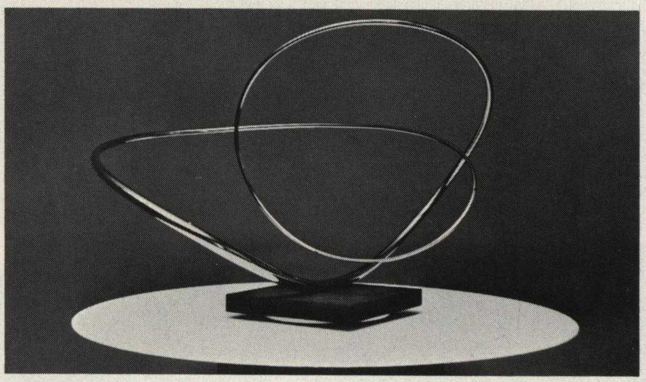


Table with glass top—mirror finish stainless steel legs, Cumberland Furniture, New York



Sculpture—by Jose de Rivera—mirror finish stainless

Barcelona Chair—by Mies van der Rohe, Knoll Associates, New York

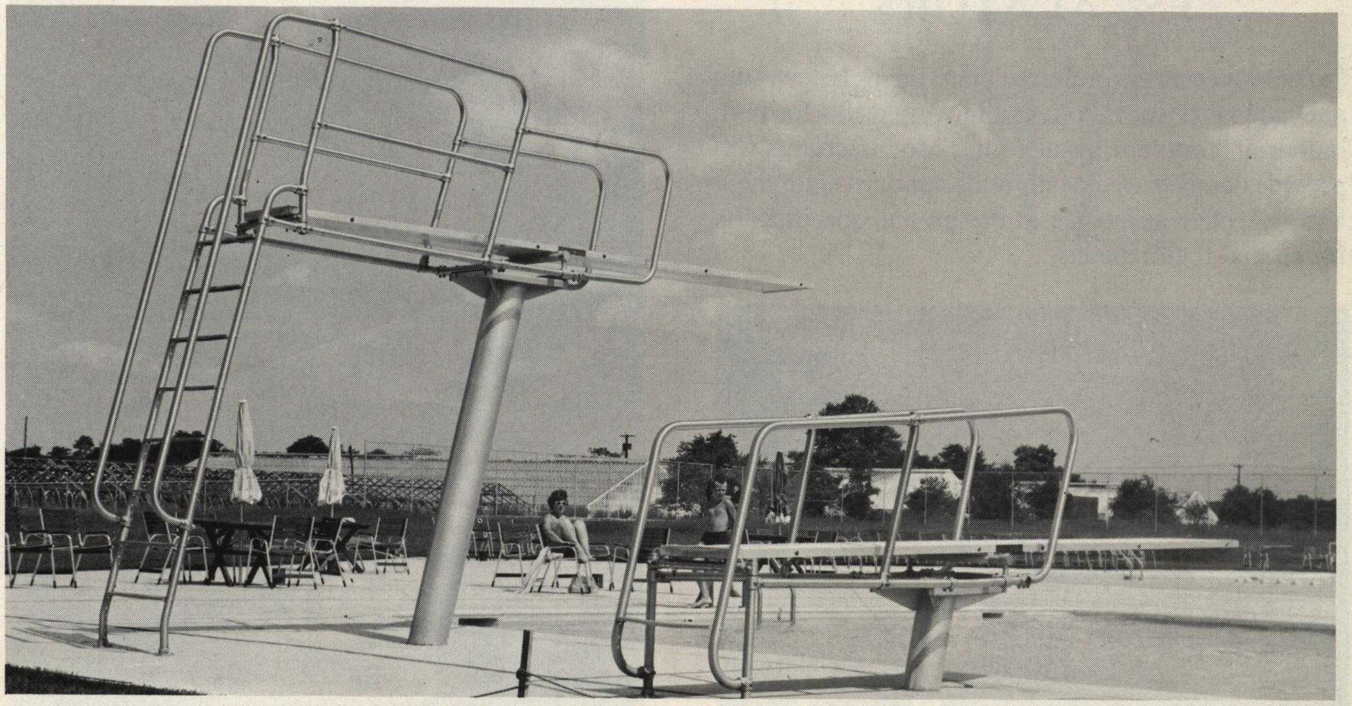
SWIMMING POOLS AND EQUIPMENT

Particularly suitable for apartment and hotel construction, the 40- by 20-foot pool shown is located on the roof of the 35-story Georgetown Plaza Apartments in Greenwich Village, New York. It was constructed of $\frac{3}{16}''$ plate of Type 304 stainless steel. This pool weighs 14,000 pounds versus 24,000 pounds for a similar pool constructed of concrete and also requires less time for installation. Savings in weight and maintenance are evident.

Pool hardware is divided into two categories: (1) products that come into direct contact with water, such as filters, underwater lights, or pumps and (2) products that are used near the pool but do not remain in prolonged contact with water. This latter category is termed "deck equipment" and includes lockers, furniture, diving boards and handrails.

Type 304 stainless steel is generally suitable for both pool and deck equipment unless exposure to salt water is anticipated. Type 316 is the preferred alloy for salt water environments.

Architects: Leo Stillman, New York
Manufacturer: Steelstyle Pools, Inc., New York



Pool equipment by: Paragon Swimming Pool Co., Inc., Pleasantvile, New York

ELEVATORS

Increasing use of stainless steel for elevator entrances, doors, frames, caps, control panels and indicators has resulted from the demonstrated performance of numerous installations. Stainless steel combines elegance and economy to provide years of service with a minimum of maintenance under conditions of heavy use.

ESCALATORS

Stainless steel is the preferred material for balustrades and railings of escalators and moving walks for both indoor and outdoor installations. Manufacturers will provide detailed specifications of standard equipment and will offer assistance in design and specification for special requirements.

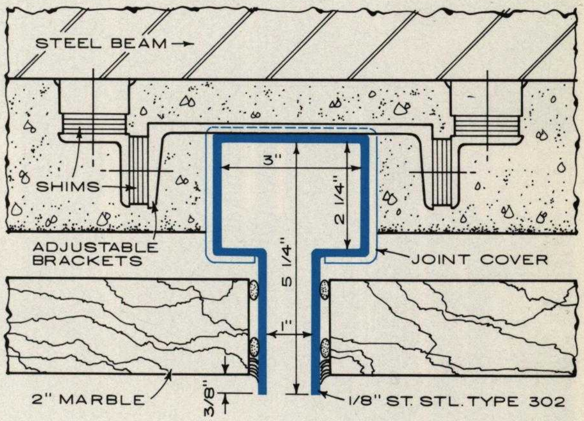
MATERIALS HANDLING EQUIPMENT

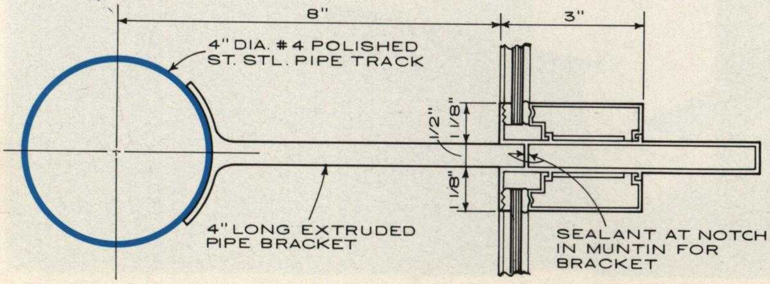
Baggage handling and conveying equipment in airports, railway and bus depots are continually exposed to heavy traffic and abrasion. Stainless steel has proven an ideal material for such items as conveyor guides and aprons, chutes, revolving carousel distributors, counter tops, railings and racks. Two typical examples are illustrated.

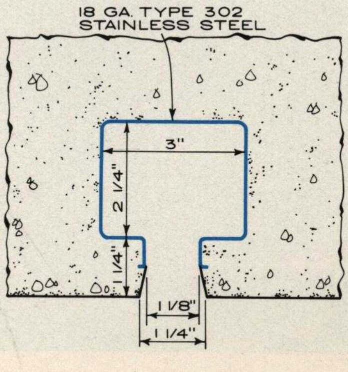
WINDOW WASHING TRACKS

Corrosion resistance and low maintenance requirements make stainless steel the most suitable material for the window washing scaffold guide tracks of high rise buildings.

There is considerable variation among manufacturers in the design of standard guide track shoes, and, in addition, many custom designs are produced. Diversity of guide track design is equalled by the variety of methods by which tracks are attached to the building structure. Tracks can be anchored directly to structural steel or concrete, supported by mullions or column covers, or cast in precast concrete panels. The track can be partially or totally exposed with polished reveals or can be completely hidden from view.



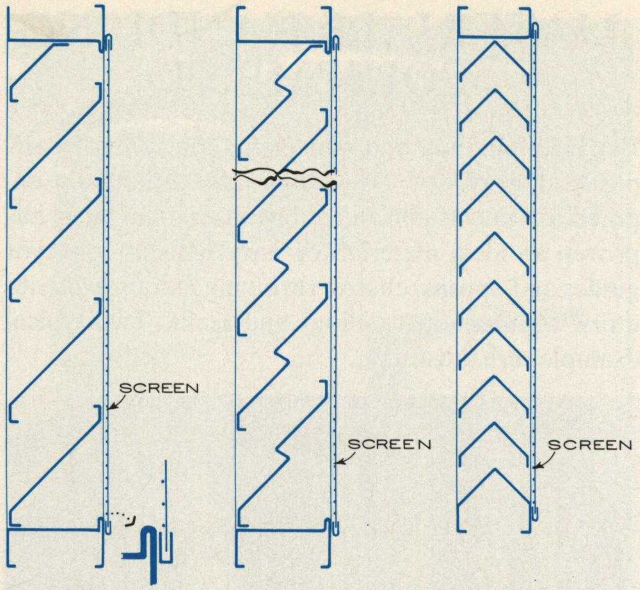




LOUVERS

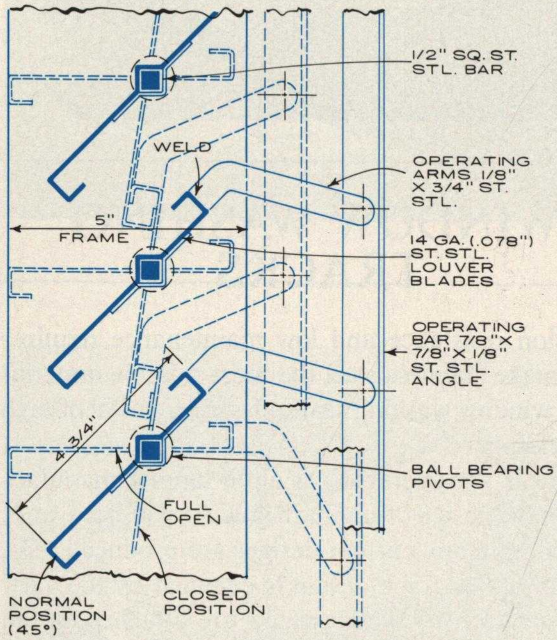
Stainless steel louvers offer the advantages of high strength, relatively light weight and low maintenance. Figure 1 shows vertical sections through typical standard louver types. Mechanically actuated operating louvers are detailed in Figure 2. Since light gauge sheet is normally used in stainless steel louvers, end attachment of vanes should be designed to minimize flutter and prevent fatigue cracking.

Operating louvers on the Philadelphia State Office Building (below) were fabricated by Albro Metal Products Corporation, New York City. Architects were Carroll, Grisdale & Van Alen; Harbeson, Hough, Livingston & Larson; and Nolen, Swinburne & Associates. Louvers at the New York Transit Authority subway ventilating building (lower right) at Columbus Park, Brooklyn, New York, are arranged in a staggered pattern.



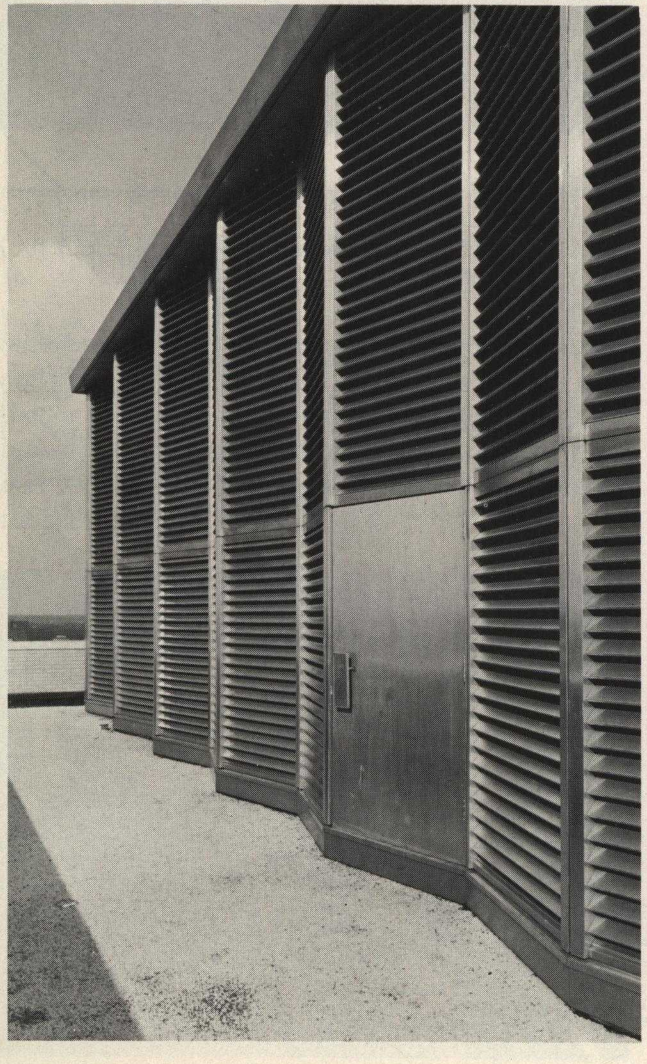
VERTICAL SECTION – STANDARD LOUVER TYPES

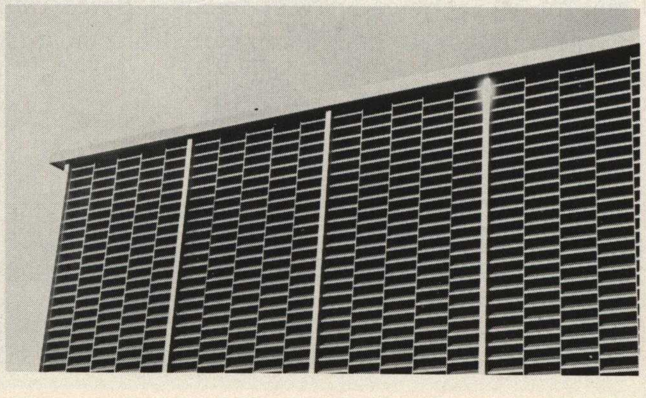
Figure 1



TYPICAL VERTICAL SECTION

Figure 2

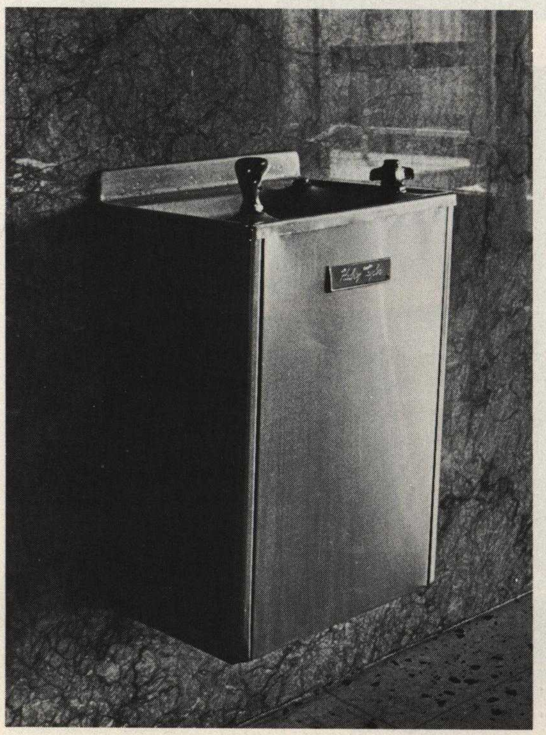


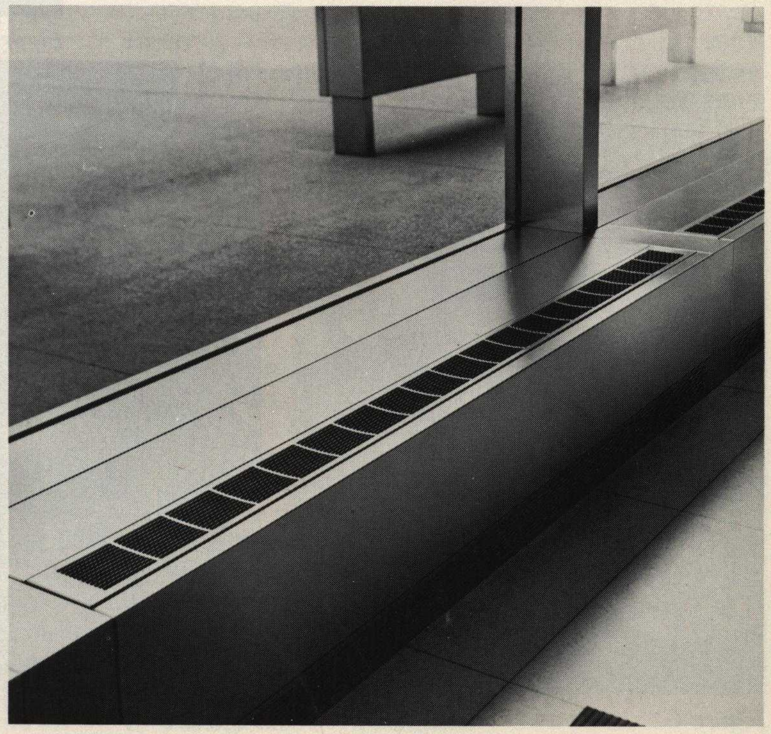


MECHANICAL EQUIPMENT

Stainless steel is used in a variety of mechanical equipment applications in which exposure to moisture presents both sanitary and appearance problems. Such applications include drinking fountains and water coolers; bath and toilet fixtures; shower stalls, wash fountains and sinks; floor and roof drains.

Also utilizing stainless steel are convectors and radiator enclosures; louvers, registers and grilles; fans, blowers and ductwork. Typical applications are illustrated.





LIGHTING FIXTURES

Illustrated on this page are a variety of lighting installations which utilize stainless steel functionally and ornamentally. Note that some examples make effective use of stock tubular sections, while others are based on more complex tapered and formed built-up sections.

Figure A—Corridor railing fabricated of 1¼″ diameter tubing has a 5-watt lamp in each wall bracket and is suitable for hospital or convalescent home use.

Manufacturer: Charles Parker Co., Meriden, Connecticut.

Figure B—Stainless steel poles at the Summit Hotel, New York City.

Figure C—Poles at Expo '67 designed by Louis Villa.

Manufacturer: Canadian General Electric.

Figure D—30-foot octagonal poles, Municipal Services Building, Philadelphia.

Manufacturer: Millerbernd Mfg. Co., Winsted, Minnesota.

Figure E—14-foot cruciform section poles, Rochester, New York Civic Center Plaza.

Manufacturer: Millerbernd Mfg. Co.

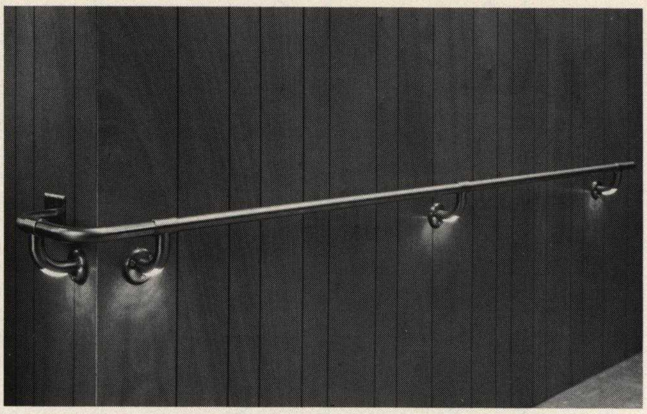


Figure A

Figure B

Figure C

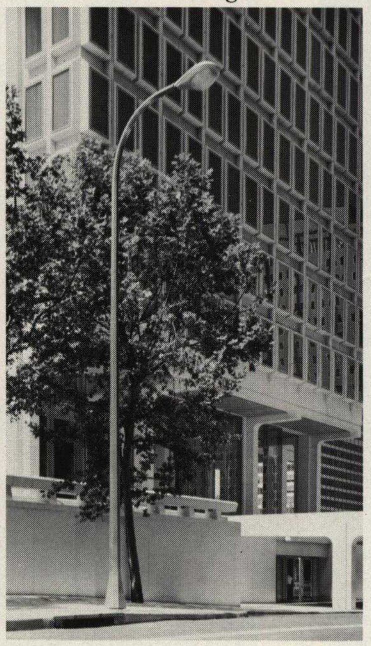


Figure D

Figure E

INDEX

P—Properties, M—Mill Products, F—Fabrication, A—Applications

P—Properties, M—Mill Products,
F—Fabrication, A—Applications

P—Properties, M—Mill Products,
F—Fabrication, A—Applications

FOR MORE INFORMATION...

We will be pleased to have you call on International Nickel regarding the selection of appropriate metals for your applications. Phone or write the nearest office.

DISTRICT OFFICES

CHICAGO, *1211 West 22nd Street, Oak Brook, Illinois 60521 / Tel. 312 325-6600*

CLEVELAND, *Investment Plaza, 1801 East 9th Street, Cleveland, Ohio 44114 / Tel. 216 621-5077*

DETROIT, *19842 James Couzens Drive, Detroit, Michigan 48235 / Tel. 313 342-4560*

HARTFORD, *1177 Silas Deane Highway, Wethersfield, Connecticut 06109 / Tel. 203 563-9391*

HOUSTON, *500 Jefferson Building, Houston, Texas 77002 / Tel. 713 224-1433*

LOS ANGELES, *Wells Fargo Bank Bldg., 21535 Hawthorne Blvd., Torrance, Calif. 90503 / Tel. 213 542-1626*

PITTSBURGH, *Four Gateway Center, Pittsburgh, Pennsylvania 15222 / Tel. 412 281-9546*

WASHINGTON, *1000–16 St. N.W., Washington, D.C. 20036 / Tel. 202 628-4255*

WILMINGTON, *Suite 1118, 300 Delaware Avenue, Wilmington, Delaware 19801 / Tel. 302 656-8248*

INTERNATIONAL NICKEL

The International Nickel Company, Inc.

One New York Plaza, New York, N.Y. 10004

A-613

10M-5-72-5389 Printed in U.S.A.